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MILITARY AFFAIRS

No. 1727

AVIATSIYA I KOSMONAVTIKA

No. 7, July 1982

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DISCIPLINE IN FLIGHT SERVICE

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82(signed to press 1 Jun 82) pp 1-3

[Article by Eng Col Gen V. Skubilin, chief engineer of Soviet Air Force, deputy commander of the Air Force for Aviation Engineering Service: "Discipline of an Aviation Specialist"]

[Text] The personnel of the Aviation Engineering Service [IAS] are diligently working with a great patriotic upsurge to implement the historical decisions of the 26th CPSU Congress trying to achieve a further increase in the quality and effectiveness of combat and political training, and the strengthening of discipline and management.

The unshakable foundation of and the most important factor in constant combat readiness and might of the Soviet Armed Forces was and remains solid military discipline, the basis of which is a deep ideological conviction and a high political consciousness of our fighting men. All aviators are required to have an even greater organizational ability and steadfastness of character and must exclude carelessness and negligence in readying aircraft and helicopters for flights.

Military discipline means first of all strict and exact adherence to order and rules that have been established by Soviet laws and military regulations. Symbolizing the ideological-ethical norm of conduct for a serviceman, it requires his exact adherence to the Constitution of the USSR and all other legislative acts, to zealously carry out the orders and directives of commanders and chiefs. The essence, forms and ways of supporting and strengthening the Constitution and the modes of conduct of the defenders of our Motherland are determined by the social structure of our country and the social nature of our armed forces. The main source for the discipline of Soviet fighting men is the unshakable communist belief in the truth of V.I. Lenin's ideas, the Great October, and a fervent dedication to our Motherland, to our glorious Communist Party and to the principles of proletarian internationalism.

The role of discipline and the support of constant combat readiness of the Air Force is growing immeasurably today in connection with changes in technical equipment of units and subunits of the Air Force. Improvements in air-

craft technology is continuous and regular, reflecting successes in scientific-technical progress and ever-growing requirements for the Air Force to resolve problems of modern war. But the development and replacement of aviation technology, as a rule, is accompanied by complications, an increase in the number of functionally interconnected elements that are subject to strict control and maintenance in the operational process. Modern aircraft equipment that is subject to control and maintenance has increased by more than two to three times. This led not only to an increase in the volume of work, but also demanded from IAS personnel narrower specialization and the knowledge to competently resolve complex problems of coordination between service groups in the course of readying aviation systems for combat.

"Now," emphasizes General Secretary of the CPSU Central Committee, Chairman of the Presidium of the USSR Supreme Soviet, comrade L.I. Brezhnev, "when the decisive role in military affairs belongs mainly to combined forces, and when success of their utilization depends on expert and coordinated action of many people, a highly developed organization, constant self-control and an unquestioning dedication by everyone is of utmost importance. Even single instances of carelessness and undisciplined behavior on the part of servicemen can lead to grave consequences." Therefore, the maintenance of aircraft and helicopters in constant combat readiness and the effectiveness of using them in the process of flight training present a high responsibility for every IAS specialist.

An integral factor in successfully resolving problems that face IAS personnel is military and technological discipline. He who attempts to divide discipline into some sort of component parts is deeply mistaken. The technical and technological aspects are the main and determining parts in the activities of IAS specialists who put into operation, as well as repair aviation equipment and perform a number of other functions. Unfortunately, there are still those chiefs in the IAS who evaluate a subordinates work from one point of view only, according to his professional mastery, forgetting that first of all, this is a serviceman who has been called upon to unwaveringly adhere to the requirements of his military oath and the regulations of the USSR Armed Forces, as well as instructions and manuals.

But discipline, as is well-known, does not come of and by itself. It is affirmed by people, and primarily by those people who head military collectives by virtue of their service and party responsibility. How things are accomplished in units and subunits, how servicemen comply with requirements of regulations, and how they adhere to rules and order, depends on the style and methods of the chiefs and their responsibility for the training of subordinates.

A reliable support for leaders of the IAS are party and Komsomol organizations. Communist party and Komsomol members contribute greatly toward good management and show a good example in expertly utilizing aviation technology and assuring flight safety. And an examplary service by members of the CPSU and the Komsomol is the most effective means for supporting strong prescribed discipline in IAS units and subunits.

Under current conditions, honesty and truthfulness of an IAS specialist carries a special meaning. To be honest means to strictly carry out instructions and technological requirements, whether or not your chief will check your work, and to show responsibility by controlling your own actions unwaveringly. To be truthful means not to hide your errors, to admit if you have made an error, and to report problems. These qualities take on a special meaning in aviation, which is the only branch of the Forces where technology is prepared by one group of people while another group uses it in flying. An error that is allowed by an IAS specialist may create an extremely difficult situation in the air. Because of this, there is a special moral aspect to the Disciplinary Regulations that requires truthfulness.

However, there is also another aspect. Aviation specialists, especially aircraft technicians, comprise the last control point, which a flight crew has to go through prior to a flight. They help the pilot from the moment that he gets into the cockpit and in preparing him to start the aircraft. A strong combat friendship develops between flying and technical personnel. But it happens, for some unknown reasons, that before flying up into the sky, something bad befalls the pilot: he is agitated, cannot concentrate and allows errors during his pre-flight check. The flight or squadron commander would naturally not allow a pilot to fly in such a state. And what about the technician? How would he act in such a case and would he be always really truthful and act according to his principles? Unfortunately not.

I remember a violation of flying service rules in one of the aviation units. A minute investigation revealed the fact that the flight crew was responsible for it. Later, however, the flight engineer of the aircraft, in a conversation with his comrades, remembered that before the flight the pilot was absent-minded and agitated, in other words, not the same as he always was. But the engineer was embarrassed to ask him what the matter was. Anyway, the specialist should not have kept silent, but should have actively intervened and used all possible means to prevent the flight of an airman who was in such an agitated state.

The Disciplinary Regulations require that each serviceman learn military matters conscientiously. For aviation specialists, this requirement is always real and very concrete. After all, in order for them to consciously adhere to military and technological discipline, each one has to thoroughly understand its essence and be a true master of his craft by knowing his aircraft well and perform preventive maintenance work on it expertly. And the highest level of mastery is manifested by the ability to fulfill requirements of regulations and manuals in the most complex situations and to assure competent operation of aircraft. This means that today, without raising the level of general technical knowledge and management, an IAS specialist, for all practical purposes, cannot perform and operate complex combat technology on a high quality level, cannot plan his work precisely, and cannot effectively utilize the flight control check apparatuses and methods of ground flight control.

Let us look at another peculiar situation which is not always taken into consideration by the chiefs of IAS units and subunits. Sometimes it happens that a seemingly well-prepared serviceman is guilty of violating established rules for operating aviation equipment. What is the reason? Conceit, laxity, non-adherence to regulations and deviation from established moral-ethical norms determine the work of these IAS personnel. self-satisfaction and over-confidence irrevocably lead to errors and miscalculations. A knowledgeable and authoritative aviation specialist, in order to remain that way, is required to constantly improve his knowledge and practices. "Unforeseen" errors and violation of regulations are the logical result of slackening demands on ones self.

In analyzing the work of IAS personnel, one comes to the conclusion that the discipline of an aviation specialist depends greatly on the general state of affairs in the subunit or unit, an exact observance of the requirements of the oath and regulations, and the maintenance of a healthy moral atmosphere in the collective. A strict adherence to regulations, notes member of the Politburo of the CPSU Central Committee, USSR Minister of Defense, Marshal of the Soviet Union, D.F. Ustinov, is an examplary execution of combat watch, guard and internal service, an efficient organization of combat and political training, a technically excellent utilization of armament, a correct interrelationship between servicemen, an exact fulfillment of the orders-of-the-day, and training plans and programs, a concern for everyday life, an intelligent organization of leisure time for personnel, and participation in mass sports.

In view of what was just said, it can be ascertained that efficient order is achieved where life goes strictly by regulation; where explanations of these regulations and their exact observance in everyday life occupy the center of attention of commanders, staffs, political workers, chiefs of the IAS, and party and Komsomol organizations. After all, an unwavering observance of the requirements of the oath of duty and of regulations testifies not only to the fact that there are no violations, but also to that special political, moral atmosphere in the military collective which denotes a high degree of conscientiousness on the part of personnel, their responsibility and their continuous readiness to carry out their sacred duty.

Today it is very important for every IAS officer to know as much as possible about law. A basic juridical competence is a most important factor in achieving results in disciplinary action with regard to subordinates when giving them orders, tasks, in making all kinds of decisions, and in organizing and conducting preventive maintenance on aircraft and helicopters that are in operation. This is why there is a high requirement for aviation engineers to create such conditions for the activities of their subordinates that it would be impossible not to observe military and technological discipline. Officers I. Rybin and Yu. Starshiy, who head aviation repair shops, can be cited as an example.

At the present time, a majority of chiefs in IAS units and subunits have become convinced that without detailed and goal-directed training, one cannot achieve an unwavering observance of established rules for utilizing and

repairing aircraft by various categories of specialists. The practice of organizing personnel activities has confirmed the necessity to systematically plan such work in all elements of the IAS. This is also important because many young engineers initially have little work experience in supporting a steadfast adherence to regulations and they have not yet developed good organizational and managerial practices for supervising subordinates during periods of intensive flight training. The active participation of engineers is also important in bringing everyday conditions and the performance of personnel into full agreement with regulation requirements.

For example, in a collective where the IAS is headed by officer G. Matveyev, there is the practice of monthly analysis of the state of technological discipline. This allows for more effective educational measures to be developed, with consideration for tasks that the specialists have accomplished. Definite valuable experience in this respect was also accumulated in aviation units where IAS deputy commanders are Major-Engineers E. Chumachenko, V. Pigulevskiy, V. Kuznetsov, and others.

I would like to emphasize especially the role that exacting work has in strengthening discipline. The officer, as a leader, is responsible for creating the necessary conditions for having his subordinates accomplish their duties. If a specialist is not provided with technical documentation for a job, if he is not given enough time to do that job, and finally, if he is given a job for which he is not prepared, then it is difficult to hope for success. The aviation repair shop headed by Officer V. Gusev did not maintain the necessary prescribed order, and control over the activities of subordinates was weakened. This led to a decrease in the quality of repair.

Some officers, who are chiefs, just assigned to a new position, at first do not know how to handle correctly their interrelationship with subordinates and either go the way of becoming too familiar with them, or, just the opposite, show themselves as being too strict and inaccessible chiefs. But when one speaks with them for a while, one becomes convinced that engineers do not know either the questions their personnel may have or their frame of mind, and they do not conduct enough individual educational work with their people.

Many years of experience testify to the fact that the acceptance of something new and a high degree of responsibility for an assigned task take hold faster when specialists have an officer in charge who possesses these qualities himself. This shows, first of all, in his work and deeds, in his ability to ensure and maintain efficient and well-organized work by servicemen, as well as in his ability to objectively, comprehensively and substantively evaluate the results of both his own work and the work of his subordinates. However, not everyone does this. For example, one can still meet chiefs of technical maintenance unit [TECh] elements who do not personally check the condition and readiness of an aircraft before giving permission for a flight, because they are afraid that such a check would hurt the feelings of an experienced mechanic, who would look upon this type of control as an expression of distrust. But such IAS chiefs are greatly mistaken. In the first place, they are not fully meeting their responsibilities, which are specified in the

appropriate documents. Secondly, the control check of a demanding and fair chief never hurts the feelings of subordinates, but just the opposite; it makes them work even better. But the personal carelessness of some IAS chiefs, as a rule, will make specialists disrespect them.

Political maturity, responsibility, principles, and party honesty are those qualities of an officer-chief which help him accomplish his duties with integrity and pride, and to carry his title of aviation engineer with honor. Working under the supervision of a commander, and being supported by the party and Komsomol organizations, our engineers are successfully solving difficult problems assigned to the personnel of the IAS.

Right now, units and subunits of the Air Force are conducting intensive summer training. Aviators in the air, on proving grounds, and in training classes are working out a complex series of various problems. In preparing properly for the 60th anniversary of the founding of the USSR, IAS personnel are working under great pressure. A reliable guarantee of achieving new successes in combat and political training is an irreproachable industriousness and a high degree of organizational management on the part of each specialist who contributes to the competent operation of modern aviation systems on the ground and in the air.

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HELICOPTERS: TACTICAL TRAINING FOR GROUND SUPPORT

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82(signed to press 1 Jun 82) pp 4-5

[Article by Colonel B. Nesterov, military pilot 1st class: "Helicopters Over the Battlefield."]

[Text] During the tactical flight exercise, helicopter crews supported ground subunit operations by unloading troops and carrying out strikes against the "enemy's" reinforced zone in the tactical rear of his defense.

In the course of the offensive it became necessary to deliver ammunition and fuel to the motorized rifle subunit that had become separated from the main forces. This responsible task was assigned to the helicopter flight commanded by Captain A. Samirov.

By the time the crews arrived at the designated zone, the ground situation had changed somewhat. The flight commander did not pay the attention he should have to this situation and his decision to deliver the loads along the shortest routes by lone helicopters was not sufficiently justified. In addition, in the process of preparing for the flights, the sequence of conducting radio communications was developed without considering that radio traffic might be monitored. The crews devoted their main attention only to flying in mountainous terrain and to landing in an area limited in size, and with a maximum gross weight. But in spite of all this, the first flights were successful. The loads were delivered to their exact destination on time. But this apparently was exactly what dulled the sense of vigilance. The crews did not practice flight security, which is what the "enemy" took advantage of, calling his fighter aircraft to that zone. To guide them, air controllers who were in the combat ranks of ground subunits were used. As a result, the fighters were able to intercept one helicopter as it was approaching the loading area after it had accomplished its mission, and the other -- before it approached the delivery area. Data from the objective control center confirmed that both helicopters had been "shot down."

Having analyzed the work of the crews headed by Captain A. Samirov and the "enemy" tactics, the commander of the helicopter unit, while the exercise was still going on, made corrections to the concept that had been developed earlier and made his decision: Subsequent flights in support of troops would

be carried out not by single aircraft, but in an extended combat formation by pairs. Optimal parameters for the formation were selected that would guarantee a reliable cover for the lead helicopter from the "enemy's" ground fire, as well as provide the crews with better observation and the possibility for helping each other in a tight situation. In addition, the navigator laid out new routes that would bypass the air defenses, and air controllers were sent to the combat ranks of advancing subunits with the mission of informing the pilots about the developing ground and air situation in the combat area, and to provide assistance to the crews in reaching their targets. The measures taken decreased the probability of destroying helicopters by ground air defenses and by "enemy" fighter aircraft. Special attention was devoted to evasion maneuvers against aircraft attacks. Helicopter pilots were advised that upon sighting an attacking fighter aircraft, to execute a dynamic forced 180 degree turn with a maximum allowable bank and overload, and during the second half of the turn, to increase the speed to the maximum limit. Together with this, a great deal of significance was attached to using terrain features and man-made obstacles for the purpose of concealing the flight. The point of the maneuver was to have fighter aircraft which were attacking from above increase their diving angle, and this naturally would lead to a decreased distance when it would open fire and would complicate aiming conditions. In addition, a real threat of danger would arise when the pilot would come out of his dive, and this obviously, would not guarantee a successful attack.

If the attacking fighter aircraft has an onboard radar, the helicopter maneuver would consist of following the terrain which would lead to a disruption in following the target, meaning that the pilot would have to shift to a visual search. As it was, the sighting of a helicopter by the "enemy" was difficult even when he would fly over broken terrain with quickly changing colors on the ground.

At the basis of the decision was the principle that the longer a fighter aircraft would remain in the zone of advancing air defense troops, the greater would be the probability that it would be shot down. In the area of possible "enemy" air action, the crews were advised to proceed to their target by periodically changing course and not flying along a straight line for longer than one minute. The time it took to search for helicopters, to develop a maneuver for beginning an attack and to finish aiming, were all taken into consideration. This kind of a flight would make it difficult for "enemy" fighter aircraft to suddenly approach the point of initial contact and would give helicopter crews the opportunity to make correct and timely decisions on evading the attack.

One should discuss the actions of air controllers separately. The regiment commander sent experienced airmen, First Class Pilots, Captains A. Pinchuk and V. Nikiforov to leading detachments of ground force subunits. Naturally, in connection with the developing scenario, their training was compressed into a short period and did not allow them to react quickly to many suddenly arising situations during the course of the exercise. Thus Captain Pinchuk, finding himself with the commander of the motorized rifle battalion, had time

for completing only a few functions: he helped the helicopters to approach the target clandestinely and to locate it, and familiarized them with the changing situation on the battlefield.

In the process of coordination, the helicopter crews and air controllers met with difficulties, because orders were received incorrectly and there was no experience in directing them to the target. In the heat of battle the air controller would show the direction of approach with his arms, forgetting about the fact that pilots should be orientated by the characteristics of ground features. Radio traffic was jammed up with wordiness and with non-standard and sometimes poorly understood orders. All this reflected on the stability and exactness of control, and consequently, on mission accomplishment as well.

It should be noted that the most effective way of leading a helicopter to its unloading area (target) turned out to be one with the aid of a portable precision approach radar, which Captain Nikiforov had. Using an onboard automatic radio compass, the pilots were able to fly right to its location. Visually sighting and identifying his own helicopters, Captain Nikiforov gave them short, precise orders on how to find the target, and after a positive identification of the target, allowed the helicopters to attack.

During the exercise it became necessary to determine the location of the forward edge of their own troops. Helicopter controllers had nothing other than portable radio-technical equipment that supported command communications and signal flares.

The experience of using helicopters over the battlefield and the experience gained by our crews during the exercise required generalization and a comprehensive study. A flying tactical conference that was conducted shortly afterwards allowed a detailed analysis of helicopter actions and tactical maneuvers that took place. As a result of the comprehensive discussions, proposals and recommendations were made. The most important of these are summarized as follows:

The helicopter is becoming an element of the combat order of battle for ground forces, and this requires the aircrew to be able to fluently "read" the battlefield. In preparing for exercises, ground reconnaissance of the area in which they will be held should be conducted by both the commander of the combined arms unit and the flying personnel. At the same time, while at that location, characteristic orientating points should be delineated that will be used by ground troops in the course of battle, and an evaluation should be made as to their unique application from the air by pilots. It is necessary to find and discuss the most probable variants in using helicopters to support motorized rifle and tank subunits. They have to learn to determine the optimal load of helicopters for carrying out specific missions, their combat armament and permissible capacity and the type of ammunition, combat equipment and other loads that will be transported. Close coordination expands the pilots' horizons and contributes to their more active and better conceived actions above the battlefield. In other words, if the helicopter crews can visualize the unified concept of the operation, they

will be able to orientate themselves more quickly and more precisely to the dynamics of modern combat. To ignore this means to program unjustified losses in advance. Advance coordination and strict control are the guarantees of success in combat involving combined forces.

In the process of mastering helicopter combat applications by flying personnel, it was discovered that it was necessary to change the methodology for carrying out air reconnaissance flights. For example, it is logical to conduct such flights over areas of tactical exercises and training of ground troops, of course, with prior agreement with the commanding staff of the combined arms unit (in those cases where the use of aircraft is not contemplated in the exercise being conducted). After completing a mission, the flight crew commander gives a written report to the staff. On the basis of reconnaissance data received, their analysis and comparison to the concept of action by ground forces, one can also determine objectively the result achieved by helicopter crews in carrying out their mission. This will help pilots acquire skills in reading the battlefield situation, give them the opportunity to provide a more correct evaluation of the developing situation and make a well- reasoned decision. In addition, there will be more training experience for aircrews in locating small, camouflaged targets, which is very important for carrying out precise strikes on battlefield targets. Creating a scenario that is close to a real combat situation will also facilitate the development of effective coordination measures for helicopter and motorized rifle (or tank) subunits.

Prior to carrying out on-site ground reconnaissance and intelligence flights (engineering, radiation, artillery fire correction, etc.), it is very important, as experience shows, to study the battle site through aerial photographs prepared from data obtained by reconnaissance aircraft. A detailed study of these photographs facilitates a more precise and quicker determination of the forward edge, which still has a lot of "blank spots" instead of designations. For leading helicopters and groups to a given area, Doppler measuring systems of the DISS type, used in conjunction with onboard cartography, help a great deal. On the other hand, pyrotechnical devices and conditional auxiliary signals merely supplement the information of the air controller and are used by him only if necessary.

Radio control plays a significant role over the battlefield in work with helicopters that are operating in close coordination with ground force subunits. We believe that in training for combat flights, a number of typical attack variants or combat maneuvers should be developed on the ground beforehand. The command to implement them should logically be given by one single code word. In informing helicopter crews about the battlefield situation, the air controller should use short coded phrases, the meaning of which is known to the aircrews. One cannot discount the possibility of giving false commands in the open, leading the enemy astray.

During the course of the exercise, specially selected reconnaissance and targeting aircrews were used to determine the forward edge of the battlefield and the targets. They preceded the basic group by a distance of maximum visibility (in good meteorological conditions) or at a predetermined time

interval. Having determined the line of troop contact (target), the reconnaissance aircrew flying over it would drop colored smoke sticks in a predetermined order, as well as release free flying rockets in the direction of the target. The aircrews of the basic groups would approach the target from different directions simultaneously. This decreased the time that they would be over the target or in the area of parachute landings, as well as their vulnerability from "enemy" fire.

The recommendations which were worked out and applied during the course of the combat exercise and in training, showed their viability and effectiveness. Pilots really felt the need to carefully analyze their actions and develop in advance optimal variants for fulfilling given mission, taking into consideration ground force tactics, as well as enemy tactics. It should be noted that problems concerning tactical training of aviators, the development of initiative and creativity in our air warriors, and the development of high moral-combat and psychological qualities are at the center of attention of commanders, staff officers, and political workers, and party and Komsomol organizations of the unit. Well thought out and organized exercises and tactical bulletins facilitated an increase in expertise. Flight tournaments brought tangible results. On the whole, flight and tactical training of helicopter crews was improved, and there was a display of self-discipline and responsibility for increasing professional readiness.

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FIGHTERS: PAIRED OR SINGLE FIGHTER DISCUSSION CONTINUED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) p 11

[Article by Guards Maj (Res) A. Zheltikov, Combat Pilot First Class: "Both the Pair and the Single"]

[Text] The idea of using a single aircraft instead of a pair is attractive in every respect. From a material point of view, this means half the expenditure of personnel and resources for accomplishing a specific goal. Also, one must consider the morale factor: Victory due not to quantity, but to quality.

With the development of aviation technology, tactics are constantly being improved, and principles for combat use of fighter aircraft are changed and supplemented. The appearance of long- and medium-range "air-to-air" missiles as an aircraft weapons system that can destroy air targets at a great distance from the release point had a substantive influence on the very nature of the fighter aircraft. Working in coordination with anti-aircraft missile complexes, the fighter aircraft expands the area in which it can protect the target. At the same time, when the interceptor aircraft is in a zone covered by anti-aircraft guided missiles, it is immune to a sudden attack by enemy fighters. Consequently, to use a second aircraft as a shield for the lead aircraft would not be logical in this case. This example addresses the advantage of a single aircraft which has the mission of intercepting an air enemy. It is in such a case that a single aircraft comprises a fire unit and even a tactical unit by itself.

Modern fighter aircraft, incorporating the latest achievements of science and technology, have a high degree of thrust, good dynamic qualities and the capability to conduct a maneuvered air battle in a broad spectrum of altitudes, from minimally low to stratospheric. The presence of onboard weapons for carrying out strikes at short distances has significantly increased the firepower of the fighter aircraft; it is capable of destroying an air enemy at distances ranging from minimally safe to relatively great, employing intensive maneuvering. And if this is the case, then the role of the second aircraft has not only not decreased, but on the contrary, has increased. The great range in weapons application creates certain difficulties in selection of an order of battle and variants in maneuvering in pairs. It requires an active, creative approach by flying personnel to individual training in piloting, firing and tactical matters.

The use of trainers takes on a special meaning. Existing trainers permit the playing of different flights variants having combat application: We shall try to redefine the traditional meanings of the terms "pair," "leading aircraft" and "succeeding aircraft" from this point of view.

A pair is two aircraft carrying out a flight at a safe interval and distance. The pilot flying in front, as a rule, is the lead aircraft; the one following him is the succeeding aircraft. If the aircraft have onboard radar sights, it is possible for the leading and succeeding aircraft to fly beyond the visual range of the two aircraft. In this case, the interval and distance are determined by the technical capabilities of the RLS [radar station] and the mission of the flight. In carrying out the mission, both the leading and succeeding aircraft coordinate the given combat formation.

The combat formation of a pair are the mutual positions of the aircraft that guarantee visual or radar communication for combat maneuvering, and which anticipate the maneuvers of both the leading and succeeding aircraft in horizontal and vertical planes, as well as in space, with the goal of taking the initial position for using missile-cannon weapons and covering one another. In accordance with the predetermined plan, in order to lead an enemy astray, the leading and succeeding aircraft, in carrying out some maneuver, may lose visual contact. The position of the paired aircraft in this case is controlled with the aid of onboard RLS and KP [command set].

During maneuvering one cannot exclude a possible situation whereby the leading aircraft would take the place of the succeeding aircraft, for example, when the distance exceeds the maximum turn radius and the pair must complete a vigorous 180 degree turn. Acting in accordance with the plan, the pilots exchange their roles. This requires a high level of training for the succeeding aircraft, so that when he finds himself in the role of the leading aircraft, he can fulfill the designated combat mission.

In summary, the following conclusion can be made: The pair, as a combat and tactical unit, not only did not lose its significance, but also acquired new qualities, which expanded the boundaries of the maneuver and firepower against an enemy, and increased pilots' responsibility for decisions concerning a given mission.

It should not be forgotten either that a development parallel to that of aviation technology is the development of REB [radio electronic warfare] technology. Thus, in mastering the combat application of the modern fighter aircraft, flying personnel must be prepared to accomplish missions under conditions of interference to their radio communications and their onboard RLS.

Success in modern combat will be achieved by the aircraft pair that can fully implement one of the many combat maneuvers that has been developed and that can precisely apply its rocket and missile weapons under specific conditions.

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AIR FORCES

FIGHTERS: PAIRED OR SINGLE FIGHTER DISCUSSION CONTINUED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) p 12

[Article by Maj S. Murav'yev, Combat Pilot First Class: "Shield and Sword"]

[Text] It seems to me that the article by Colonel V. Belyayev, "Pair or Single?" is very timely. The problems of tactics and the conduct of air battles have always been of current interest, but today more than ever, because the combat capabilities of third generation supersonic aircraft have increased many times over. Modern aircraft have high maneuver characteristics and automatically controlled armament, and are capable of conducting air battles using rocket and cannon weapons, carrying out strikes against distant targets under practically any kind of conditions and with good results. But it has not become easier for the pilot. On the contrary, since tactics and combat application of fighter aircraft in modern air battle have grown more complex, the opposite is true.

The experience of the Vietnam war, in which the Americans used the best fighter and fighter-bomber aircraft, showed that in air battles they utilized groups having different tactical designations; during air raids they started using radio electronic countermeasures both on command channels, as well as radar sight channels. In order to successfully break through the PVO [air defenses], the aircraft "went" to small altitudes, where the distance for detecting them by ground equipment and fighter aircraft decreased, and this substantively influenced the effectiveness of their use of onboard missiles.

All this increased requirements toward both pilots and commanders who directly participate in combat actions and in the control of air battles with fighter aircraft. It also increased the requirement for them to know modern tactics, the methods of destroying an enemy under complex circumstances, and know how to plan and develop variants of battles, to make decisions on deploying forces, both quantitatively and qualitatively, in groups comprised of different tactical designations.

These problems are examined in professional literature and are used by commanders in flying personnel in modern fighter aircraft tactics, as well as in developing a single point of view on their application in air battles. This point of view, to which I also adhere, is based on the premise that modern

air combat has, as a rule, a group character. As far as single combat concerned, it may be an episode of group combat when the group falls apart into separate units, and also in cases when enemy flights are repelled at night or in clouds.

Modern fighter aircraft, armed with multi-range missiles, can carry out strikes against the enemy, disrupt his plans and break up his order of battle from great distances beyond visual range. If, however, for some reason, the enemy was not destroyed in the first strike, his destruction has to take place in close maneuver combat, where there is a high probability of success. Intensive radio and radar interference is used especially when combat activities are conducted at low and minimally low altitudes. In air combat, it is possible to use the missiles of all aircraft of the group simultaneously with individual aiming.

As reported by the foreign press, in local wars fighters flew in groups, in which the combat unit was a pair. Combat formations were echeloned at different altitudes in pairs or in groups broken down by pairs. Often used for dispersing enemy combat formations and carrying out sudden strikes were one or several pairs of fighter aircraft, which were in an ambush position at low altitudes. Groups broke up into pairs and single aircraft, which then performed the maneuvers for carrying out missile strikes.

In this way, several fighter aircraft in air combat carried out missions which were much more complex than if they had been carried out singly. In battle where the enemy has a tactical advantage, the group can juxtapose such forms of tactical coordination that would significantly decrease or eliminate his advantage.

Of course, in modern air battle it is difficult to maintain visual contact in the process of intensive maneuvering by groups; therefore, it is entirely possible to temporarily lose visual contact between pilots. Consequently, for assured and stable group coordination, flying personnel need to develop the practice of flying together in pairs and elements in different combat formations, as well as combat maneuvers within the framework of the flight training program.

A group maneuvered air battle by modern fighter aircraft is based on complex aspects of combat training, and requires flying personnel to completely master piloting and the use of missiles and cannons during complex maneuvers both singly and in groups. Therefore, it is not by coincidence that when the qualification level of "Military Pilot First Class" is awarded, only those pilots who are prepared to conduct combat under any weather conditions in a group receive this rating.

In a real battle the pilot of a single aircraft is deprived of fire and tactical coordination. He will have to count only on his own expertise and chance (if communications with the KP [command set] are disrupted, and the pilot does not know the nature of enemy actions). At the same time, in carrying out combat, a group which has preserved its fire power or tactical coordination, is capable of achieving results of such quality that would not

be possible to achieve by using the same number of single aircraft. In addition, the presence of a large number of single aircrews in the air would create a complex air situation, in which it would be difficult for the command post that is directing the air battle to determine what is going on.

With respect to modern aircraft pairs, it seems to me that every pilot is both a shield and a sword. This means that an enemy will be attacked by the pilot in a combat formation for whom it is easiest to use his weapon while his partner backs up the attack and, if necessary, applies pressure. Such tactics assume a similar high level of professional training on the part of both pilots in the pair.

Dispersed combat formations are now considered to be the most logical. The succeeding aircraft does not have to try to maintain strict parameters of the formation. It is much better, depending on the circumstances, to change one's place during the maneuver. This would permit the lead aircraft to utilize every capability of his own aircraft. For example, when the entire group makes a turn of the type "everybody turn at once," all pilots use full throttle and maximum angular velocity. The time spent on such a maneuver is equal to the turning time of a single fighter aircraft, but upon ending the maneuver, the position of the aircraft changes, depending on the initial combat formation. Accordingly, it can be concluded that the pair as a combat unit has become more mobile and, depending on the nature of the maneuver, the roles of the leading and succeeding aircraft pilots will change in the course of preserving fire power coordination. In other words, the pair comes out as a fire power and tactical unit, and it is entirely possible that it will preserve its predesignated function in the future.

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FLIGHT TRAINING: COMBAT FLIGHT TACTICS DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 18-19 and rear cover.

[Article by Colonel-Engineer S. Bytko, candidate of military sciences, docent: "Before the Air Battle"]

[Text] It is possible to decrease the passive time in conducting an air battle if maneuvering is done not in the horizontal plane, but in space. Executing three-dimensional maneuvers allows an increase in the angular turning speed of the horizontal trajectory projection at the expense of the angle of climb (or descent), as can be seen from the formula, $W_{gor} = \frac{n_y}{V} g \frac{\sin \gamma}{\cos \Theta}$. The increase in angular speed is especially perceptible when the angle, Θ, is greater than 30 - 40 degrees. Decreasing time and increasing angular speed during three-dimensional maneuvers provide the opportunity for using the velocity excess to gain altitude or make a vigorous turn against an enemy. The latter situation allows the attacker to observe the enemy and, if necessary, anticipate his attempts to evade the attack, that is, preserve one's own tactical superiority. Thus, three-dimensional maneuvering is offensive maneuvering, through which the maneuver characteristics of an aircraft are used as fully as possible for achieving victory in an air battle.

The pilot should remember that the loss of speed, which is unavoidable in three-dimensional maneuvering, causes (if the load factor is constant) an additional increase in angular speed, W_{gor} (in addition to its increase at the expense of maneuvering with Θ angles) and a decrease in its turn radius (see the formula, Fig. 1, and the back cover of AVIATSIYA I KOSMONAVTIKA, No. 6, 1982). This dependence of W_{gor} and R_{gor} on speed is preserved only until the aircraft attains the allowable angles of attack. Piloting an aircraft with a constant α_{dop}, which, as already noted, is not desirable, leads to the opposite: a decrease in W_{gor} and an increase in R_{gor}. Let us demonstrate this visually: From the formula, $n_y = \frac{C_y \rho V^2}{2G/S}$, let us find the ratio $\frac{n_y}{V}$, which is part of the equation for $W_{gor} = \frac{n_y}{V} g \frac{\sin \gamma}{\cos \Theta}$. We shall write down the expression for overload: $\frac{n_y}{V} = \rho V \frac{C_y}{2G/S} V$, or, assuming that $C_{y\,dop}$, G and S are constants, we get $\frac{n_y}{V} = K \rho V$, where $K = \frac{C_y}{2G/S}$ is a constant coefficient when α = const. Since the multiplier pV decreases during an altitude-gaining maneuver, $\frac{n_y}{V}$ also decreases. This causes a decrease in W_{gor} and an increase in R_{gor} during a maneuver. This means that it would be prudent to maneuver in such a way so as to decrease the piloting time with a constant α_{dop}.

2. In Space

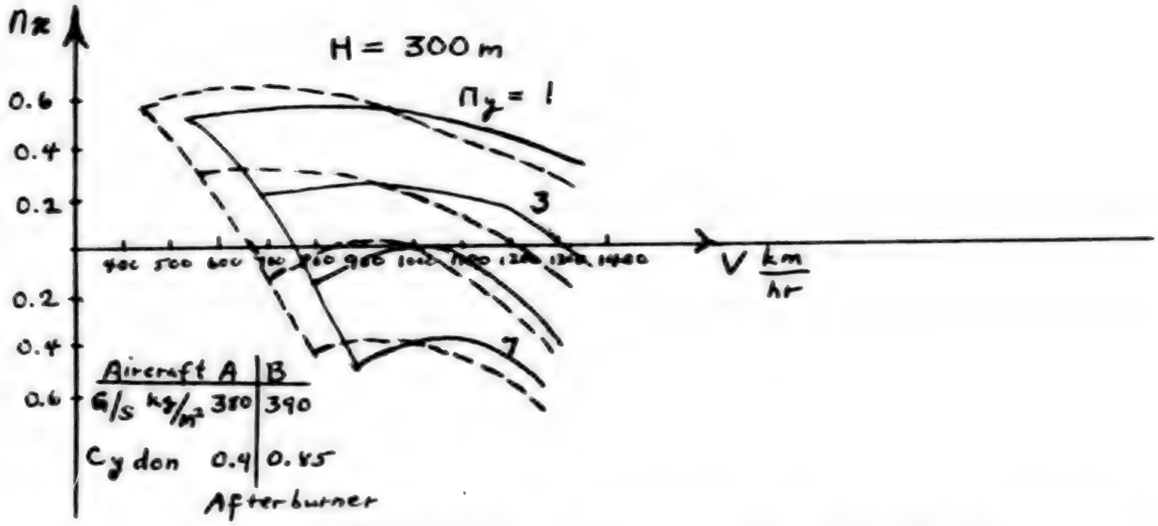


Fig. 1. Grids of Generalized Characteristics of Aircraft Being Compared.

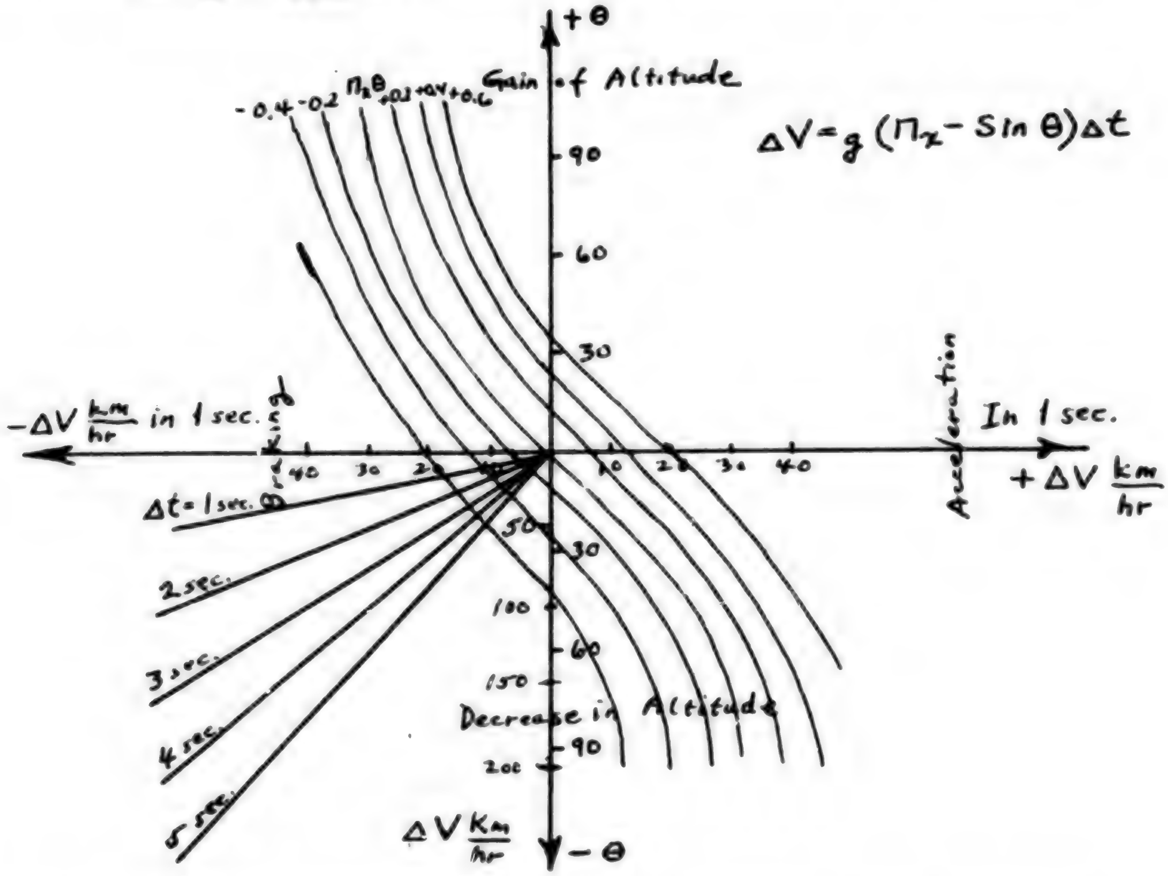
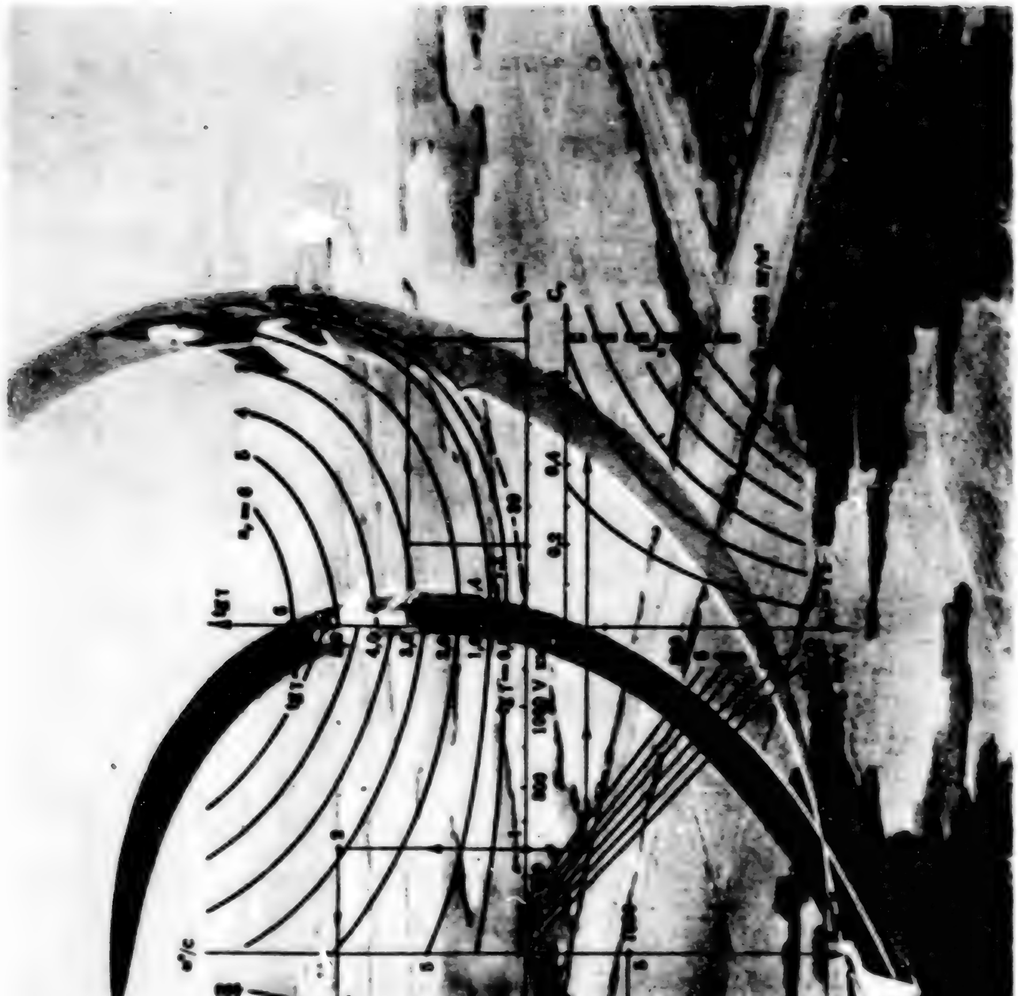


Fig. 2. Nomogram for Evaluating the Value of the Change in Velocity Excess from Angle O and Overload .



Before the Air Battle (Rear Cover)

How can three-dimensional maneuvers be modelled? It can be done with the aid of grids having generalized characteristics of aircraft being compared, that is, the dependences of marginal overloads $n_x = n_x(V; n_y)$ (Fig. 1), the graphic dependences in the changes of flight velocity $\pm\Delta V$ on the size of the angle of climb (or descent), and on the longitudinal overload n_x (Fig. 2). It can also be done with nomograms for ascending and descending spirals (Fig. on back cover). We shall model in the following sequence: With the help of grids showing generalized characteristics, we shall designate logical overloads (angles of attack), velocities and maneuver altitudes for conducting air battle; on the graph (Fig. 2), we shall find the allowable limits for changing Θ angles and flight velocities that support the pilots' maneuvering in an advantageous region (in relation to the overloads, $n_{y\,ycr}$; n_x); we shall select logical piloting figures and the parameters of their execution, and evaluate the possible win (or loss) in $\Delta V, \Delta \varphi, \Delta \Theta$, and ΔN.

For comparison, we shall use the grids of generalized characteristics for arbitrarily designated aircraft A and B on Fig. 1 for N = 3000 m. In the range of velocities, from V_{min}, determined by the allowable angle of attack, to 925-1000 km/hr, aircraft A has superiority in p_{x_r} and $p_{y_{ycr}}$, independent of the maneuver overload factor (line p_{x_r} for all overloads, p_y , is higher than for aircraft B). At great speeds, aircraft B has the advantage, and the pilot, in order to preserve his power superiority, would be prudent not to decrease his speed by less than the ones stipulated. But how can this be achieved? Let us take n_x quantities from the graph for the following intersection points: $n_y = 1$ and $n_x = 0.58$; $n_y = 3$ and $n_x = 0.28$; $n_y = 5$ and $n_x = 0$; $n_y = 7$ and $n_x = 0.39$.

On Fig. 2, find the designated angles of climb for the indicated n_x : Θ_{ust}= 35°; 16°; 0°; and -24° . To make it easier to remember the relationships between the angles, Θ , and the overload, n_y , one can make use of the following approximate formula (only for the aircraft being examined):

$$n_y = \frac{35-\Theta}{10} + 1.5$$

For the pilot of aircraft B, the above formula means that he can remain in the advantageous velocity range if, while he is maneuvering at different angles, he does not exceed the overload factor found by the formula. For example, in executing a combat turn or an oblique loop with an average climb angle of $\Theta = 30°$, the overload factor should not exceed $n_y = \frac{35-30}{10} + 1.5 = 2$, and for descent, $\Theta = 20°$ $n_y = 7$.

In order to determine the maximum angle, Θ , corresponding to the overload that takes place, we shall use the formula, $\Theta = 50° - n_y \times 10$, that is, if the overload factor created is, let us say, 4 units, then angle Θ , in a maneuver, should not exceed $\Theta = 50 - 4 \times 10 = 10°$.

On the other hand, lower velocities, right up to the point of recovery at minimal and measurable $C_{y\,dop}$, are advantageous to the pilot of aircraft A. For this reason he should try to maintain overload factors greater than those indicated, but not exceed the allowable angle of attack according to the indicator.

Inasmuch as the pilots of neither aircraft have overload limitations, they can execute any maneuver. For the pilot of aircraft B, in order to preserve his power superiority for a longer period of time, it is more advantageous to fly with smaller n_y values than what we found by using the formula. But for the pilot of aircraft A, it is the opposite: Larger overloads are more advantageous. This does not mean that the pilot of aircraft B cannot create large overloads during maneuvers. He can use overloads right up to the maximum, but he must remember that if the aircraft goes into an undesirable velocity range (under 950 km/hr), the power superiority will pass to the pilot of aircraft A and will accumulate with every second that the aircraft is in this velocity range. Thus, the battle tactic for the pilot of aircraft B comes to maneuvering (we are speaking of prolonged maneuvering) at high velocity.

Let us now determine the maximum power penalty (in n_{x_A}) for the pilot of aircraft B. As can be seen from Fig. 1, his maximum value will be at the velocity of 650 km/hr at $n_y = 3$ and will reach $\Delta n_x = 0.15$. On Fig. 2, we see that independent of velocity and flight altitudes, for identical angles, θ, the difference $\Delta n_x = 0.1$ supports the corresponding relative velocity measurement between aircraft, $\pm\Delta V = 3.5$ km/hr, for every second. Correspondingly, at $\Delta n_x = 0.15$, if identical , maneuvers are executed at $V = 650$ km/hr, aircraft A will have acceleration relative to aircraft B that is one and one-half times greater, equal to 5.25 km/hr in one second. In other words, in 10 seconds he will increase his relative velocity from 0 to 52.5 km/hr.

In order to determine the ultimate parameters for both aircraft when executing a spiral type combat turn, let us use the graphics in Figs, 1, 2 and the back cover. For $V = 650$ km/hr and average altitude of $H = 3000$ m $n_y = 3$ (Fig. 1), $n_x A = 0.35$; $n_x B = + 0.2$. The angles of the established spirals (Fig. 2) are, $\theta = + 20°$ and $+ 12°$, respectively. With the aid of graphic functions shown in the upper right quadrant (drawing on the back cover), we shall find that for the spirals -- executed with angles, $\theta = 20°$ and $12°$, respectively; and $n_y = 3$ -- the banking angles, γ are equal to $73°$ and $71°$, respectively.

Next, in the sequence brought out in this drawing, we shall find the turn radii: $R^A = 1050$ m, $R = 1120$ m, and $\Delta H_A = 1280$ m and $H_B = 750$m. Time for the turn into angle $\Delta\phi = 180°$, and is equal to 19 secs. and 21 secs., respectively. As we can see, the difference in the radius and the turn time is relatively small and does not provide a perceptible gain (turn at $180°$). More perceptible is the difference in gaining altitude, when $\Delta H = 530$ m. In the range of altitudes we are looking at, we assume that the overload value, n_x is constant and equal to an average value. In connection with this, one should not select a range of altitude changes (or turn angles) that is too great, so that substantive calculation errors can be avoided. In our example, a 650 km/hr velocity at an overload of $n_y = 3$ for aircraft B is the minimum allowable and is limited by the recovery at $S_{y_{dop}}$. If the pilot of aircraft B should hold on a $20°$ angle, then the aircraft would lose a velocity of 5 km/hr every second, and in 19 seconds it would slow down to 555 km/hr. However, the pilot should not allow this to happen, since already at the beginning of the maneuver, when $V = 650$ km/hr, $n_y = 3$, and $H = 3000$m, the

aircraft is at the boundary of the allowable angle of attack; a further increase (decrease in velocity) is impossible due to safety considerations. For this reason, at this velocity he has to gain altitude at angles of $\theta < 12°$.

Thus, knowing the values of the radii and the movements of aircraft for given intervals of time (angles of turn), one can graphically, using a suitable scale, reproduce the trajectory of the movements of two fighters in an air battle and calculate their mutual positions at any stage of engagement.

The basic principles of modeling an air battle between two aircraft have been presented here. After having understood them, every pilot, in the process of preliminary training for an air battle, can relatively quickly make calculations regarding those maneuvers that interest him, without violating flight safety conditions. That is, he can formulate his own tactics competently and ahead of time.

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AIR FORCES

HELICOPTERS: FLIGHT TRAINING FOR HELICOPTER UNITS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 20-21

[Article by Lt Col A. Lapshin: "Group, Take Off!"]

[Text] A gray fog covered trees, bushes and the propeller-winged aircraft that stood nearby with a thick blanket. The quiet of the morning watch was now and then broken by the soft voices of technicians and mechanics.

The squadron commander, Lieutenant Colonel B. Yeliseyev, worriedly kept looking at the face of the onboard chronometer. Take-off time was approaching. According to the meteorologist, the cloud should lift soon, but through experience in flying in this area, Boris Prokof'yevich knew that the prognosis could also be wrong. The flying-tactical training in which the personnel staff of the squadron was now participating had brought forth increased interest: it was a new theme and an unusual mission.

The squadron commander had no doubt about the air training of his subordinates. He had flown with many of them from the first day that he took command of the subunit. Of course the fog could interfere greatly in accomplishing the tactical mission. In accordance with conditions for tactical flight exercises, groups of helicopters had to approach firing positions within a strict time limit, locate the targets and destroy them with volley fire. A certain number of minutes were devoted to this task. If the flight could not take place in the allotted time, the mission could be aborted.

With the first rays of the rising sun, the fog began to thin out and through it you could see the outlines of trees. "We must start the engines," thought Yeliseyev. As if he had heard him, the flight leader gave the order:

"Five-hundred and first group, start your engines!"

The loadbearing rotors quickly began gathering speed.

A more precise metecrological report came in. The lowest edge of the clouds and visibility along the route was nearly minimal for the aircrews.

The engines were warmed up and tested. The pilots were ready to lift their aircraft at a minute's notice. Finally, the awaited order rang out through the earphones:

"Group, take off!"

The helicopters hung over the earth in pairs for a time and then quickly disappeared beyond the forest.

Ground fog concealed orientation points here and there. But the low cloud cover and the low altitude of the flight guaranteed an undetected flight into the strike area.

...The flight in the right echelon is strictly adhering to the formation. The commander's wingman position is being flown by the deputy of the political unit, Major V. Spiridonov. Following him is the pair, Element Commander, Major A. Titov and his wingman, Captain Yu. Pushkov. They are all experienced air fighters. It is no accident that this group was charged with the most responsible mission of locating camouflaged tanks, weapons and other armament, of selecting the optimal maneuver, of being the first ones to carry out a strike against the "enemy," and of supporting the work of the flight following behind. After the helicopter attack, motorized riflemen will begin their offensive. For this reason the strike against enemy weapons had to be intensive, exact and impossible to resist.

Lieutenant Colonel Yeliseyev led his group out into the search area. Now they had to locate the target quickly. The area was known only by the data provided by air reconnaissance. Way back during preliminary training, the commander had insisted that his subordinates carefully learn the flight routes and the area of the exercise. And he himself thought out the possible variants for concealing tanks, weapons and other firearms. And now this came to be of great use, just as regular training in the subunit had been in locating real targets and characteristic orientation points that were familiar only through photographs and maps.

Here is the ravine and beyond it is the edge of the forest. It does not look as if there is any sign of the "enemy." But the squadron commander located the target. Its coordinates were transmitted immediately. The helicopters taking on combat formation carried out the missile strike. The second element was at the initial point. Attack! And the rotored aircraft disappeared beyond the tree crowns.

The group belonging to Military Pilot First Class Lieutenant Colonel Yeliseyev received an outstanding rating. Many direct hits into the target were recorded.

The chief of the regiment political section called Lieutenant Colonel Yeliseyev's name first when naming the best officers of the unit.

"The work of Boris Prokof'yevich has been used as an example more than once," said the political worker. "Judge for yourselves. All squadron flying missions are always evaluated by the highest marks. The squadron commander and his deputy for political work, Major Spiridonov, have been able to organize combat and political training of subordinates well. It is said about people who have strongly tied their lives with the army and had dedicated

themselves to military service that they have a strong inborn 'military sense. And Boris Prokof'yevich has this. He completed the Syzran' Higher Military Pilot Aviation School. Yeliseyev approaches work as a party member should, by being demanding of himself and his subordinates. In the squadron they do not know haste, emergencies or strain. Everything, as they say, is laid out on the shelf. And no unexpected events confuse the commander. He knows how to determine immediately what is important and how to place his people correctly. This is why they are always ready at the proper time."

The service buildings of the squadron are all orderly and everything is clean. The person on watch is always certain to find out the purpose of a visit and carefully checks documents. Posters are placed on stands throughout the corridors and training models are found in classrooms. The staff has created a colorful display dedicated to the 60th anniversary of the founding of the USSR. Next to it are photographs of the best people in the squadron, who have distinguished themselves in combat and political training. The latest newspapers are put out in a place where it is comfortable to read. Everything is done with a heart and with a love for work. The servicemen relate well to their service obligations, and seriously and diligently work as hard as they can in everything they do.

The squadron commander spoke about people and about how it was thanks to their efforts that the combat subunit became outstanding.

"I was lucky with my deputy for political affairs, with the chief of staff, and in general, with my subordinates. And we overcame difficulties working together, as they say, shoulder to shoulder..."

Boris Prokof'yevich took over the squadron five years ago. There was a perceptible different in training pilots. There were many young men. He knew that as long as the pairs and flights of aircraft are not flying well together, they will not meet with success. At first he studied the people, their work qualities, and the strong and weak sides of their characters. Together with the party worker he established a solid party activist organization. The commanders real assistants became Senior Lieutenant A. Savochkin and Captain N. Kozhukh, both party members, as well as other activists. Their ability, purposefulness and determination helped overcome the difficulties. The primary mission at that time consisted of training aircrews for combat action within organizational groups during daytime and under normal meteorological conditions. Each aircrew flew well by itself, but this was not enough. It was necessary to achieve closely coordinated group formation flying. They had to do a lot of work, and persistent work.

The squadron tactical flight exercise became the first important test. The aviators handled the mission well and received the right to participate in the combined arms exercises. In this combat work, army friendships grew stronger, as did mutual understanding, and the character of people was strengthened.

With each year the tasks grew more complex. The commanders taught their subordinates and learned themselves. There were both successes and failures.

In working at different test ranges, not everything went smoothly all the time. Worst of all was the matter of flight security. The altitudes at which they flew did not, for all practical purposes, allow the aircraft to approach their targets undetected. During training, radars often locked in on helicopters even before they began their combat course. This happened because pilots did not know the area well enough, incorrectly selected their flight routes, and did not use, to the best possible extent, ground relief characteristics and ground cover for concealment. Their knowledge of ground force tactics was also deficient. After all, the primary mission was precisely to work in close coordination with them and for their best interests. When they were preparing for their final check, flights to the test ground were made in conjunction with work on coordination with ground subunits. They tried to achieve precision, to the second, in approaching their target. They timed themselves by exploding rockets.

One time, during a squadron LTU [tactical flight exercise], they received a mission to provide fire support to motorized riflemen who had gone on the defensive. According to intelligence data, the "enemy" was preparing to strike the right flanks of the defenders with a tank group comprised of two platoons. There was no time to prepare. The question arose as to whom to send. They quickly discussed all the personnel of the group. It was composed of the squadron navigator, Military Pilot-Sniper Captain V. Arzhayev, and pilots, Captains N. Kozhukh, V. Vorotnikov and V. Demidov. It was headed by Lieutenant Colonel Yeliseyev. Military Pilot-Sniper Lieutenant Colonel B. Luk'yanenko helped work out the tactical strike plan before the flight. They laid out the route on the map and calculated the approach to the control reference points and to the combat course.

The calculations made by Captain Arzhayev proved to be exact. The group approached the attack line at the time it was supposed to. But just then a message came from the KP [command post] to the effect that the "enemy" had been able to move his tanks to another area. Coordinates were only approximate. Yeliseyev sent Arzhayev's aircrew for reconnaissance, and he and the rest of them concealed themselves in an ambush position.

During their studies and tactical flights, the aviators studied tactical and technical specifications of tanks and other combat equipment. And they familiarized themselves with the training ground during preliminary training. This knowledge allowed the distance that the tanks could cover over the transpired time to be calculated exactly. Captain Arzhayev's crew, that had been sent out for reconnaissance, detected the tanks on the march. A short command was given over the air. The rotor-bladed aircraft, diving out of their ambush position, suddenly appeared over the target. The data of the control center confirmed that the tank group had been destroyed.

It would seem that this kind of success would give reason to be happy, especially since the exercise director gave a high evaluation to the group. However, gathering the flying personnel together, Yeliseyev worriedly spoke about how he had experienced difficulty in selecting the aircrews when this stituation had come up. After all, everyone in the squadron, without exception, and in any combination of personnel, should be able to accomplish a

similar mission. Thus, the squadron commander had established a new parameter to combat training. And work continued.

First of all, he strengthened the flights where there was a predominance of young aviators. The best prepared flyers were assigned to lead aircraft pairs. They had to prepare themselves for combat action under adverse meteorological conditions, organized by pairs and flights. The squadron Deputy Commander for Political Affairs, Major V. Spiridonov, took a great part of this work upon himself. A first-rate pilot himself, he found the time to conduct party-political work and fly as an instructor.

An important element in moral-psychological training is the simultaneous firing by all onboard weapons. The combat aircraft is literally wrapped up in a sea of fire and smoke. Also, the behavior of the helicopter changes in these moments. The commanders diligently taught their subordinates to master this aspect of combat application.

Many problems arose. But, thanks to persistent and goal-directed work, they were gradually resolved. By the time of exercise "Zapad-81," the squadron was outstanding. With the beginning of the exercise, all the personnel threw themselves into combat work. They prepared for flights with special effort, with the kind of thoroughness that excludes the smallest insufficiency and does not leave anything unclarified. On the first day, Lieutenant Colonel Yeliseyev led a group of helicopters into battle. He knew how important it was to get his subordinates off to a good start right away.

Specific minute counts were given for attacking ground targets. The strike was to be carried out against specific targets immediately after an artillery preparation. For this reason, the commander devoted special attention to locating targets through auxiliary reference points.

When they approached the combat course, the picture that opened up before them stunned them at first. An artillery barrage had just been completed. Clouds of dust and smoke rose above the ground, and through them nothing could be seen. The pilots' whole attention was directed at locating the targets.

An indistinct silhouette passed through the smoky veil. Yeliseyev could not even believe his eyes. But this was really a weapon. The wingmen were ordered to attack. Fire! And an immediate maneuver. A second group continued the work of the commander's group. They were also successful.

On the second pass the helicopter crews carried out a powerful strike against the tanks.

"Group, withdraw!" came the voice of the aviation controller over the helmet earphones.

A turn, and the helicopter took a heading for the airfield.

Victory! Yes, this was a triumph of will, courage and mastery, the ability

to use these very short moments which crown persistent labor. But that is after all the whole point of the matter; only he who is prepared for it can make use of an opportunity to the fullest extent. And subordinates of officer Yeliseyev were ready not only for a chance happening.

The squadron participated in the exercise from the first to the last day. The aviators demonstrated their ability to fly together well, as well as the solid organization of their group. They provided cover for crossings and parachute drops, they parachuted themselves, and they carried out strikes from ambush positions. And the combat collective accomplished each and every mission masterfully...

Now the regiment is studying the lessons of exercise "Zapad-81" comprehensively. New methods are being developed for carrying out strikes against ground targets and for coordination with ground force troops. The squadron, which had until recently been headed by Lieutenant Colonel Yeliseyev, goes forward, not relinquishing its leadership in socialist competition under the slogan, "A reliable defense for the peaceful labor of the Soviet people!" Recently, another commander took over the squadron. And Boris Prokofyevich received a new assignment, leaving behind a reliable replacement. We want to wish him with all our heart the same persistently achieved successes in combat and political work in his new assignment, and in his helping our air warriors increase their combat readiness, as well as in strengthening discipline and organization.

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AIR FORCES

FLIGHT SCHOOLS: CADETS' TACTICAL TRAINING DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 22-23

[Article by Colonel A. Konovalov, military pilot first class and Lieutenant Colonel O. Basmanov, candidate of military sciences: "Tactical Training of Cadets"]

[Text] "Seven-hundred fifty-fourth, you are being attacked by fighters to your left rear!" Cadet A. Zakharov heard the voice of his instructor over the helmet earphones, and he replied:

"I understand."

The bomber, obeying his order, made an anti-fighter maneuver.

"We are approaching the boundary of the ZUR [anti-aircraft guided missile] fire," warned the navigator.

Again, a powerful maneuver, and the "enemy" PVO [air defense] system was broken through. The cadet received permission to approach the proving ground. The bomber was on its combat course. The aircrew was working together well. Bombs away! The target was destroyed by direct bomb hits.

Analysis showed that the future pilot precisely accomplished all elements of his flight check and deservedly received an outstanding rating. That day other cadets had also performed well. Good results were achieved thanks to thorough and comprehensive training which had been organized by the flight instructor staff, together with instructors from the tactics department.

As is known, the basis for professional training of beginning pilots is flight practice. It unites into an integrated whole, knowledge, habits and skills received in the process of studying theoretical disciplines, among which tactics has a special place. This discipline is irrevocably tied in with the flight training of future air warriors, because it gives them a concept of how to implement required knowledge of aviation technology, aerodynamics, weapons and the practice of piloting an aircraft to achieve success in battle. The quality of professional training of cadets will be better in direct proportion to the durability of this tie. Because of this, the com-

mand and the instructors of the tactics department of our school see as their primary mission the kind of organization in the training process that is based on practice flights and studies on practice flights, and is unified with these flights in a cohesive manner.

Experience in working on take-offs shows that cadet mastery of means and methods of using their aircraft in combat depends equally on the instructors, who give them theory on tactics, and on the flight instructor staff, which implements their knowledge in practice and makes it into a skill. Joint work on the part of instructors, commanders and teachers should be organized from the beginning of cadet flight training. Thus, the department of tactics in our school gives tasks to the teachers during the period of flight training, to develop jointly with instructors and commanders specific professional skills on course subjects. Naturally, training begins with the ABC's and goes from the simple to the complex. For example, teachers, instructors, engineers and technicians familiarize the cadets with the organization of airfield and material-technical flight operations support, and the duties of various officials. Special attention is devoted to studying the location of airfield structures, and airfield security and defense. Cadets during this period are enrolled in combat analysis, and they participate in practical exercise on airfield defense. Under the direction of teachers and chiefs of the training regiments' chemical service, the young aviators learn to defend personnel and equipment from weapons of mass destruction; they develop courses of action for landing on a contaminated airfield, for flying through a radioactive cloud, and perform work on decontaminating airfield equipment, as well as on camouflage. Exercises on flight control are conducted right on the study site by control officers and command post specialists.

Thus, from the very beginning of training, future pilots become familiar with the basics of flight work organization under combat conditions, and special atttention is devoted to studying every aspect of combat action support to aviation squadrons.

Later, cadets receive their flight experience in combat application of an aircraft, and here the tactical direction of their training changes. The primary emphasis is on training aircrews to carry out a "combat" flight and to overcome the "enemy's" latest PVO system. At this stage, the theoretical knowledge that cadets received is used by them in practice, by carrying out flights in a conventional tactical situation with anti-missile and anti-fighter maneuvering and bombing runs. Also, the situation gradually becomes more complex.

Each new training stage is preceded by comprehensive training in the squadrons, in the course of which the young aviators study the planned exercises, instructions to the pilot (crew) that correspond to some situation, and methodological aids; and before the flight for bombing practice, they study the theoretical bases for this type of training. The full mastery of subjects is facilitated by the instructors of the tactics department, who conduct studies on subjects that reveal the essence of a modern combined arms battle, how the enemy organizes the covering of his troops through PVO methods, and how to overcome these methods.

While training the cadets to fly under combat conditions, it was found that tactical conferences on overcoming PVO by groups of attacking bombers, as well as group exercises, have much to recommend them. Experience has shown that such studies significantly increase the quality of training of future pilots, especially if the regiment command staff participate in them. Reports at conferences of squadron commanders and the best flight instructors who have a great deal of flying experience, increase the emotional acceptance of the subjects under discussion by the cadets.

A real combat situation and everyday training conditions differ substantively, but the basic elements of the combat flight and its emotional background can and should be created already from the beginning.

The squadron commanded by Lieutenant Colonel V. Zotov has established its own traditions and its own approach to solving training problems. It is significant that in this collective, while training young aviators for flying in a conventional tactical situation, the command and instructor staff devoted special attention to their individual training. During this time, with the aid of tactics instructors, they develop models of "combat" flights, select tactical modes for overcoming PVO along their route, learn the functions of aircrews during aircraft maneuvering, and determine the beginning and ending parameters for these maneuvers.

After this, the flight instructors teach cadets the placement of PVO sites along the flight path, select variants of structuring an order of battle depending on the flight profile, the type of target and the method of carrying out the strike. Special attention is paid to formulating the crew commander's flight map and other documentation. Instructors of the tactics department help young aviators enter the tactical situation on the map, assess the capabilities of the "enemy" PVO, and select the most effective methods of breaking through it. In addition to the situation map, the instructors widely use models of the site on which, using the "dismantled flight"[peshiy po-letnomu] method, they and the cadets develop the sequence of actions by aircrews in approaching the testing ground. Preliminary flight training ends with training in aircraft cockpits and monitoring of readiness to carry out a mission, accomplished at first by flight commanders and then by squadron commanders.

This form of preflight training facilitates in cadets a tactical way of thinking and develops both their ability to analyze the situation quickly and thoroughly, as well as to make rational and creative judgements.

The results of exercise accomplishments are thoroughly analyzed. At the same time, the analysis of combat situation flights is conducted in the squadron by analogy and in the sequence in which questions were given that were to be analyzed under combat conditions.

All this contributes to the cadets' confident mastery of combat application of complex aviation technology. Their good theoretical training is a solid foundation for future improvement of their professional and tactical mastery.

Every year lieutenant pilots leave the walls of military aviation schools. They are ideologically confirmed defenders of the skies of the Motherland, highly educated, technically qualified officers. Thorough theoretical knowledge received in training auditoriums is applied in practice. And the growth of their combat mastery depends a great deal on how well they were trained in school to make independent decisions on complex problems. Today's air warrior is first of all a tactician who is capable of operationally comprehending a developing situation, make a correct decision in the minimum time possible, make the enemy bow to his will and achieve victory. The development of a tactical way of thinking is a complex and multi-sided process that requires from commanders and teachers a creative approach to training cadets and a constant search for effective methods of presenting material. Where the theory of special disciplines is closely tied in with practical flight training, there the air warriors receive solid knowledge which will contribute to their future formation.

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USE OF APPROXIMATED FLIGHT INFORMATION IN MI-2 [HOPLITE] TYPE LIGHT HELICOPTERS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 26-27

[Article by Senior Lieutenant A. Pesterev, military pilot-instructor second class: "Calculation in Your Head"]

[Text] In carrying out tasks of transporting and delivering cargo, combat equipment and airborne troops, helicopter crews have to fly along complex routes and approach the target or drop area at a strictly designated time. In doing so, the pilots and navigators effect control and course correction according to distance, that is, they determine their ground speed and the time it took to fly a given distance. To do this, the crew uses different calculating instruments (NL-10, NPL and others), special apparatuses and navigational aids. But in a complex and quickly changing situation where there is no time, it is often necessary to do approximate calculations in your head, in order to prevent gross errors in helicopter piloting, especially for pilots of the Mi-2 type light helicopters. They cannot use a calculator, because they have to constantly pilot the machine. Under these conditions, the ability to count in one's head allows an evaluation of received data to be made and proper action to be taken in case onboard apparatus and navigational systems give inaccurate readings.

Basic methods and recommendations for doing calculations in one's head are given in textbooks and aids on helicopter piloting. Let us consider only how to determine ground speed. When elapsed time consists of minutes, it is not complicated to determine the ground speed once you have experience. If, in addition, it is also counted in seconds, then it is difficult to calculate the ground speed in your head by the well-known methods. An interesting law was noted in the process of flying. In order to understand it, let us introduce conventional designations: t_{el}-- exact time elapsed to fly given distance S_{ke} ; t_{cu} -- time interval, divided into parts of an hour for convenience in piloting helicopters (3 minutes, 6 mins., 9 mins., etc., every 3 minutes); $\Delta t = t_{cu} - t_{el}$ is the difference between the time interval and the exact time elapsed, S_{ke} in seconds; V is speed, for which S_{ke} is given in 3-minute, 6-minute, etc. intervals. (S_{ke} = 20 km - 6 minute segment for V = 200 km/hr, S_{ke} = 8 km - 3-minute segment for V = 160 km/hr; W is ground speed, obtained as a result of the calculation; W_{fact} is the helicopter air speed traveled S_{ke} distance over the time t_{el} ; $\Delta\Sigma$ is the error arising in calculating $\Delta\Sigma = W_{fact} - W$.

Experience shows that the size of the time segment, $\Delta t(s)$, is tied to the increase of the standard speed ΔW (km/hr), by the following mnemonic rule: for a 3-minute segment: $\Delta W = \Delta t$,

for a 6-minute segment: $\Delta W = \frac{\Delta t}{2}$,

for a 9-minute segment: $\Delta W = \frac{\Delta t}{3}$, etc.

For example, ground speed has to be determined when S_{ke} = 20 kms was flown in 6 mins. 40 secs. The problem is solved this way: Assume that we fly 20 kms in 6 mins., which is V = 200 km/hr. If, however, we fly this distance in t_{el} = 6 mins. 40 secs. $> t_{cu}$, then the ground speed will be less. By how much? We apply the rule: For a 6-minute interval (S_{ke} = 20km is a 6-minute interval for V = 200 km/hr) the increase in speed is $\Delta W = \frac{\Delta t}{2}$, but $\Delta t = t_{cu} - t_{el}$ = 6 mins. - 6 mins. 40 secs. = - 40secs. From this, $\Delta W = -\frac{40}{2} = -20$ km/hr. Thus, $W = V + \Delta W = 200 + (-20) = 180$ km/hr. In doing this, not to mix up the signs, one should simply remember that ΔV should be subtracted from V when $t_{el} > t_{cu}$. In other words, we fly the same distance in a greater amount of time, which means, speed W will be less than V and we should add ΔV when $t_{el} < t_{cu}$.

One more example. To determine ground speed, if S_{ke} = 24 kms flown in 8 mins. 30 secs. Solution: If 24 kms were flown in 9 mins., then V = 160 km/hr. Here, the t_{cu} is 30 secs. short of 9 mins., but for a 9-minute segment $\Delta W = \frac{\Delta t}{3} = \frac{30}{3}$ =10 km/hr. Therefore, W = 160 +10 = 170 km/hr. If we determine W_{fact} by the calculator, then we get W_{fact} = 169 km/hr, that is an error $\Delta\Sigma = W_{fact} - W = 169 - 170 = -1$ km/hr. This kind of exactness satisfies us.

Further, we have to determine the ground speed if S_{ke} = 30 kms was flown in 11 mins. 20 secs. S_{ke} = 30 kms is a 12-minute segment for V = 150, $\Delta t = t_{cu} - t_{el}$ = 12 - 11 mins. 20 secs. = 40 secs. For a 12-minute segment, $\Delta W = \frac{\Delta t}{4} = \frac{40}{4}$ = 10 km/hr. Thus, $W = V + \Delta W = 150 + 10 = 160$ km/hr. With the NL-10, W_{fact} = 159, that is $\Delta\Sigma$ = -1 km/hr. This kind of exactness also satisfies us.

In order to calculate W for any S_{ke} in your head, after flying S_{ke} read the t_{el} from your watch and determine with which t_{cu} it should be compared (with 3,6,9,etc.), so that Δt would be minimal; for what V is this S, 3-,6-,9-, etc. minute intervals, determine $W = V (\pm \Delta W)$ according to the above rule.

It should be noted that some pilots experience difficulty in determining the speed for which S_{ke} is a 3-,6-, or 9-minute interval. It is not difficult to find V for a 3- or 6-minute interval. In the first case, in order to obtain V, multiply S_{ke} by 20; in the second case, multiply by 10. But to obtain V for a 9-minute interval is more complex. Here you have first to divide S_{ke} by 3 in order to find the distance traveled in 3 minutes, and then by 20, to determine how far you would fly in one hour. Complications arise when S_{ke} is not divisible by 3 without a remainder. In this case, it is recommended to take S_{ke} as the sum of a digit divisible by 3 plus or minus 1. Thus, what happens is that the entire operation results in an increase of $\pm$ 7 km/hr. of speed, corresponding to $S_{ke} \pm 1$. This figure, in any case, is divisible by three.

Where do we obtain ± 7 km/hr? We shall show it to you with an example. We have to find V, when S_{ke} = 28 kms is a 9-minute interval. 28 kms is not divisible by 3, so we depict S_{ke} as the sum of 27 + 1. Then, in 3 mins. we travel $\frac{27+1}{3} = \frac{27}{3} + \frac{1}{3} = 9 + 0.33$ kms; in 6 mins. it is $2(9 + 0.33) = 18 + 0.66 \approx 18 + 0.7 = 18.7$ kms, and in one hour $V = 18.7 \times 10 = 187$ km/hr. This is where we get ± 7. If S_{ke} is + 1, you have to add 7; if it is -1, subtract 7. Assume that S_{ke} = 25 kms traveled in 9 mins. What is the value of V? For S = 24 kms, V = 160 km/hr. Here we used + 1 km, therefore, V = 167 km/hr. If S_{ke} = 23 kms, for S = 24 kms the value of V = 160 km/hr (we used -1 km), therefore, V = 160 - 7 = 153 km/hr. After similar training, it will be easy to determine V for any time interval.

From the above it follows that by changing speed by 10 km/hr, for a 3-minute interval at a given speed the time will change by 10 seconds, for a 6-minute interval -- by 20 seconds, for a 9-minute interval -- by 30 seconds, etc. If the speed is changed by 20 km/hr, the interval figure is doubled; if by 30 km/hr, the interval figure is tripled, but the errors increase at the same time.

Calculations in your head can be used to make timely decisions: At what minimum distance within the allowable maneuvering operational speed range should required speed be set? That is, find W_{potr}, using S_{ost} and t_{ost} (speed maneuver for approaching the KPM [flight terminal point] (or PD) [expansion unknown] in the given time.) For example, a 32-kilometer segment with a speed of 160 km/hr can be traveled in 12 minutes, and there is another 10 minutes, according to calculations, before reaching the target. We have to find V_{potr}. If we increase the speed by 10 km/hr, then, according to the above rule, we shall gain 40 seconds in a 12-minute interval, but we need to gain 2 minutes (120 seconds). Consequently, our speed must be increased by 30 km/hr, that is, set V to equal 190 km/hr.

Or, S_{ost} = 18 kms, t_{ost} = 5 minutes. Find V_{potr}. In 6 minutes, at S = 18 kms, we would have to travel at 180 km/hr, but we need to do it in 5 minutes (Δt = 60 seconds). Here, $W = \frac{\Delta t}{2} = \frac{60}{2} = 30$ km/hr, that is, $V_{potr} = 180 + 30 = 210$ km/hr.

You can also find t_{ost} using S_{ost} and W. Let W_{ke} = 167 km/hr. How long will it take us to travel the distance when S_{ost} = 12 km? If we travel 12 kms when V = 120 km/hr, then the time equals 6 minutes. But we are traveling at V = 167, the difference in speeds is 167 - 120 = 47 km/hr. At a 6-minute interval, $\Delta t = 2\Delta W = 2 \times 47 \approx 100$, thus t_{ost} = 6 minutes less 1 minute 40 seconds = 4 minutes 20 seconds.

The above examples show that with enough training, a pilot working out for himself the necessary number of calculations in his head, can solve any problem on finding speed, distance and time. Taking into consideration the fact that the error in this method of calculation equals zero at a ground speed of 180 km/hr and is acceptable for calculations in the range of W = 100 $\div$ 140 km/hr, this method is useful for helicopter and light aircraft pilots. It will help them accomplish flight missions with a high degree of quality.

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SUPPORT SERVICES: FIRE PREVENTION METHODS DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 30-31

[Article by Colonel V. Tkachenko, chief of inspection of Air Force Fire Protection Service: "One Does Not Play With Fire"]

[Text] Having finished listening to the pre-flight orders of the deputy squadron commander for the aviation engineering service, technician and officer N. Klimushin thoroughly examined the aircraft, checked the condition of the fire prevention equipment and the grounding apparatuses. Convinced that they were in operating order, he began to prepare the winged machine for flights.

The night before Klimushin attended a training session on fire prevention training. Engineers, technicians, mechanics and specialists of the support subunit repeated the rules of fire prevention and practiced ways of extinguishing fires, using training aids. During his flight shift, the technician performed his duties in strict accord with instructions.

Prior to towing the aircraft to a shelter after its flights, Klimushin checked the fuel leak. He placed a dry drip-pan under the drainage outlets of the aircraft and grounded the combat machine well. The contemporaries of Senior Lieutenant of Technical Services Klimushin were also thoroughly observing precautionary measures. The personnel of an aviation garrison devote unceasing attention to fire prevention training.

Protection from fire on today's airfield has become extremely important. For example, the danger of fire at an aviation technology parking area in comparison with any other one has increased: Here are concentrated fuel, ammunition and compressed gases. In addition, fires on aircraft (and helicopters), and in fuel lubricating material, missile, bomb and shell storage areas are fast-burning and potentially explosive. Fire can lead to the deaths of many people and the loss of significant material resources.

A correct procedure is followed in units where, for fire prevention on airfields and housing areas, systematic and purposeful preventive work is conducted. The main thing is to train personnel in safety rules and to require strict adherence to them, otherwise there is the possibility of a fire.

Draining fuel from the aircraft, Warrant Officer S. Ovsyankin did not bother to ground either the winged machine or the fuel truck. Two drivers, Privates Sh. Rasulov and N. Shemyakin, parked the APA [airfield power supply] automobiles and the fuel truck right next to the aircraft. All that was needed was a tiny spark to set off a fire.

And here is what happened in the TECH [Technical Maintenance Unit] of an aviation regiment, where officer A. Larionov has the duty for fire prevention maintenance. Before removing the engines here, they used to save the ones which has used up their service life. In so doing, they crudely violated fire safety rules and the corresponding instructions. They did not use oil pans for pouring off oil and fuel, and incorrectly connected the apparatus for feeding fuel to the turbo-starter. As a result, fuel got into the engine hatches and on the concrete pad. When the turbo-starter was turned on, the aircraft body burst into flames. The troops ran to the stand that had fire fighting equipment, but the only extinguisher they found there did not work. The fire was put out, but it caused heavy material losses.

Sometimes it happens that from a thrown-away cigarette butt that has not been put out or from a bare wire short circuit, aviation equipment, machines or ammunition packing will start burning. Life confirms a well-known truth: Deviations that at first glance seem insignificant with regard to fire safety rules and requirements of instructions on carrying out special work, may lead to serious consequences.

What then are the elementary measures of fire prevention that are required of every aviator?

In the regiment where officer Klimushin serves, personnel are constantly being reminded that it is categorically forbidden to smoke near the aircraft. This order is strictly obeyed by all officials, regardless of their military rank or duty. Also, one cannot work as a welder, store flammable materials in hangars and shelters, or drive internal combustion vehicles into them (automobiles, motorcycles, motorized equipment, etc.). Technicians and mechanics of this unit are especially careful when refueling aircraft. They always remember that lubricating materials are sometimes more dangerous than gasoline.

Statistics show that fires start mainly because of careless smokers, the dripping of fuel or oil on hot engine parts, as well as the discharge of static electricity. In order to avoid fires and accidents, Klimushin's fellow soldiers never put the fuel truck closer than five meters from the aircraft and are always sure to ground it before fueling or defueling the aircraft. They place the fuel hose nozzle squarely into the fuel tank opening with the aid of a small metal cable and a contact pin, and hold it with their hands until they are finished fueling. Aviation specialists know that here you cannot fasten a spigot with improvised materials and leave it without watching while fuel is being drained; it may jump out and fuel will spill out. If, despite all, fuel gets under the aircraft or on it, engines should be started only when the fuel is completely removed from the aircraft covering and the ground or concrete pad.

In using oxygen dispensing stations, technicians and mechanics, while filling onboard oxygen equipment, attentively watch to make certain that oil and POL products do not get into oxygen containers or onto the armature of oxygen tanks, or else there can be spontaneous combustion accompanied by an explosion. In working with an oxygen dispensing station, they adhere exactly to additional safety measures: For lubricating a compressor they use only glycerin and water-glycerin mixtures; they service the station in clean, greaseless, special clothing and with clean hands; they maintain all auxiliary equipment (buckets, funnels, etc.) in a clean state. Servicemen smoke, light matches and use open flames only at a distance greater than 50 meters; they do not use oxygen to air out or dry small parts and mechanisms for other auxiliary operations; and they do not repair containers or apparatuses that are pressurized.

Carelessness can lead to fires, both on airfield mechanized support equipment and on aircraft and helicopters being serviced. This type of equipment should be carefully and thoroughly prepared for use in the service area. In this regard, the unit where Senior Lieutenant V. Turan is the fire brigade chief, follows procedures correctly. Prior to leaving for the airfield, he personally inspects all special automobiles and gives detailed instructions to the drivers. And it is not by accident that there are no violations of fire regulations here while supporting flight shift changes.

While setting up aviation equipment, the colleagues of Senior Lieutenant of Technical Services Klimushin exactly follow the prescribed safety distances. In the garrison it is forbidden to construct buildings heated by stoves, as well as to smoke and use open flames at a distance of less than 50 meters from aircraft. Pads, hangars and shelters are well equipped with fire fighting tools in accordance with established norms. The Regulations for Internal Service call for fire extinguishing equipment to be stored on shields which are placed in visible areas in such a way that they will not impede taxiing before take-off. Aircraft technicians and chiefs of technical services are responsible for maintaining and correctly using fire fighting equipment. They see to it that fire extinguishers are operational on aircraft pads, in shelters, in TECh's and other places, and check whether there are seals and technical certificates on starting mechanisms. They take appropriate measures if they find mechanical damage on the cylinder or the control mechanism.

It is important to remember the following: To check whether the fire extinguisher is in working order, you cannot open the valve because you will not be able to determine the amount of the charge anyway, but the carbonic acid will escape from the apparatus. For example, Senior Lieutenant Taran checks all fire extinguishers twice a year in the fire brigade. If necessary, they recharge them here.

As is known, fire teams are assigned from among the specialists working on aviation technology or with armament and ammunition. Their mission is to control adherence to safety measures and, in case of fire, to extinguish it immediately. And during flights, no matter how many aircraft are in the air, the fire brigade of the support unit moves its combat team out on fire trucks. It carries out a combat mission. Its composition and sequence of duties is determined by a table for fire posts, approved by the commander.

The team also includes two rescue persons. Senior Lieutenant Taran never fails to check their special fireproof equipment and their fire rescue apparatus. The servicemen are well trained in all methods of leading people out of burning and smoke-filled structures. The team always has direct radio-telephone communication with the flight director, his deputy and the engineer command post.

Everyone who is subordinate to officer Taran strictly follows regulation and instruction requirements regarding the support of flight fire safety. They exhibit a high degree of vigilance, unbending resoluteness and initiative. They understand their great responsibility for the well-being and lives of people and for the safety of combat equipment, and airfield buildings and structures.

The commander of the operational alert team is subordinate to only two persons, the flight director and the chief of the fire and rescue service (fire brigade) of the military unit. The flight director determines where this subunit should be located. The location is supported by an electric hookup system to warm up the pumps and the water tanks of fire trucks. There should be a clear route from the subunit location to the runway and a good monitoring view of aircraft (helicopter) take-offs and landings.

After completion of work or flights, duty personnel and responsible officials check aircraft pads, shelters, technical positions, and storage areas for fuel and ammunition. They immediately eliminate whatever fire safety deficiencies they find. Only after this are the different areas turned over to the security guards.

Carrying out fire prevention measures systematically and adhering strictly to fire safety rules will guarantee the reliable storage, servicing and utilization of aviation materiel.

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PROGRESS IN AVIATION DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 34-35 [Please note that this is the conclusion of the article the first part of which appeared in "Aviatsiya i kosmonavtika," No 6, Jun 82.]

[Article by M. Mishuk, Hero of Socialist Labor, laureate of the Lenin Prize, Doctor of Technical Sciences, professor: "Progress in Aviation"]

[Text At the beginning of the 1950's, we began developing in our country serial production of aircraft, fitted with powerful domestically manufactured jet engines. This was convincing evidence of the high state of knowledge in science and design in the USSR.

The introduction of a jet power system into aircraft construction meant that a new stage had begun in the development of aviation technology. The well-known general designer, A. Mikoyan, in reminiscing about that period, wrote: "In our days, before our eyes, a new, higher stage began in the development of aviation. In order to make clear what a huge qualitative jump this was, I shall cite one example. A pre-war fighter aircraft had approximately a 1000-2000 horsepower motor. If, then, we convert the thrust of a modern fast aircraft to that old measure, we shall get a figure on the order of 40-50 thousand h.p. The power of an aircraft has increased several tens of times."

Design bureaus engaged in developing aviation engines, headed by A. Lyul'ko, A. Mikulin, V. Klimov, S. Tumanskiy, N. Kuznetsov, A. Ivchenko, S. Izotov, P. Solov'yev and others, worked out many new solutions. This facilitated the rapid development of our jet aviation.

As far back as 1945, the design bureau headed by A. Tupolev, began work on a new aircraft, the Tu-4. This aircraft was to incorporate the latest achievements of world aviation design: new materials, semi-finished products, and modern systems for equipment and armament. It would have been difficult to build such a plane without the introduction of more perfect technological processes and a substantial reorganization of production work in aircraft plants. The successful accomplishment of an important task assigned by the Motherland, the serial production of the Tu-4, was possible because of the tremendous help given by our party and government both in organizing work and in mobilizing collectives.

This work comprised the transition stage in creating the heavy, super long-range Tu-85 bomber. In addition, the Tu-4 continued the line of development for long-range aviation. This was the largest four-motored aircraft in the USSR having the greatest specific load. Its take-off weight was over 100 tons, and its range, with a load of over 5000 kilograms, was over 12,000 kilometers.

Research continued. Soon afterward the design bureau built the experimental Tu-82 aircraft with 35-degree sweptback wings. Important data were obtained during testing, which later formed the basis for further improvement.

A short time later, the Tu-16 entered the inventory of the VVS [Air Forces]. The sweptback wings and empennage, the unusual and bold decision regarding engine configuration and its successful external form gave it good flight characteristics which surpassed all the prognoses of specialists. Without exaggeration it can be said that during this period the Tu-16 was the best aircraft of its class in the world. The aircraft proved to be outstanding in operations; it was simple and exceptionally reliable.

The increasing scope and importance of issues resolved by our VVS, and the development of aviation technology in leading capitalist states brought out the problem of also having to further improve our jet fighter aircraft. In connection with this, new difficulties presented themselves to our aerodynamicists. After all, it was still the struggle for speed, height and armament effectiveness of combat aircraft. The OKB [Bureau of Experimental Design] began working on overcoming the sound barrier. Combat aviation required more perfect winged machines. Designers were unanimous in their views: Only aircraft with sweptback wings could satisfy the requirements and needs of combat units. There was also a new need for better rescue equipment and pressurized cockpits for safe flights at great altitudes.

The orderly system of the development of Soviet aviation during the post-war period and the increased potential of the aviation industry allowed the USSR to create a powerful Air Force. In the mid-1950's, the Soviet Union implemented large-scale serial production of completely modern jet aircraft, such as the Mig-19 frontline fighter, the Yak-25 all-weather night fighter-interceptor, the Il-28 frontline bomber and the Tu-16 long-range bomber. They comprised the primary air power of the USSR to the end of the decade.

They were replaced by new, even more improved fast and high-altitude aircraft which were shown at the July 1961 air show in Moscow. The show decisively demonstrated that the USSR had achieved new successes in aircraft design. Speed, range and ceiling of domestically produced aircraft increased immeasureably. Supersonic jet aircraft of different types were demonstrated: Fighters, armed with "air-air" missiles; heavy missile carriers; new air transport giants; "Mig's" and "Yak's," "Su" and "Tu," "An's" and "Ils"; flying boats and others.

These were aircraft of a new generation. Soviet aviators set many world

records with these aircraft, which raised high the honor of our socialist Motherland and the prestige of Soviet aviation technology. And the most complex individual and group acrobatic maneuvers testified to the exceptional mastery of our magnificent pilots who had perfectly mastered the new winged machines. The flying platforms were equipped with more improved piloting-navigational systems, automated control systems, as well as the latest radio-technical and radio-electronic apparatuses. This allowed the aircrews to confidently carry out flying missions along complex routes at any time of year or day and under unfavorable climatic conditions.

The achievements of aircraft builders were demonstrated at the Domodedovo airshow in 1967. This was evidence of the gigantic efforts of the party and of all Soviet people directed at further strengthening the power of the socialist state, the reliable stronghold of all peace-loving and progressive forces.

Today our aviation is capable of successfully carrying out missions not only in the interest of strengthening the country's defensive capability, but also in the interest of the national economy. Aeroflot passengers make journeys in comfort on such modern and fast airliners as, let us say, the Il-62, Tu-154, Yak-40, Yak-42, the Il-86 airbus and other domestically manufactured aircraft.

In the "Basic Directions for Economic and Social Development of the USSR for 1981-1985 and for the period up to 1990," it is emphasized that there should be "development of essentially new types of transportation modes, as well as transport energy installations that will substantially decrease the expenditure of fuel and energy." For resolving this important problem, delineated by the 26th CPSU Congress, our country today has unlimited potential, above all its powerful material-technical base and highly qualified scientific cadres.

The Soviet people have resolved and are resolving the difficult problem of further developing our aviation in a complex and uneasy international setting.

The clearly expressed class character of intentions of war against the USSR catches ones attention. Thus, in the "Dropshot" plan it is pointed out that "the most serious threat to the national security of the USA is the very nature of the socialist order." The main objective of a war against the Soviet Union is the liquidation of the socialist state and the establishment of a world-wide hegemony of the USA. In trying to implement these plans that are monstrous for peoples and for the cause of peace, the ruling circles of the USA and the military leaders of the Pentagon place great hopes on strategic aviation as one of the important ways of delivering nuclear weapons to the target. However, the inevitable threat of a destructive retaliatory strike has forced the ruling circles of the USA to assess more soberly the prospects of war with the USSR.

The entire strategy of Reagan's administration consists of a global utilization of American military potential as a main instrument for achieving mili-

tary superiority over the USSR for appropriating the "right" to force its dictates on other countries and for initiating aggressive acts in any area of the world. It is sharply increasing the threat of a breakout of a world nuclear conflict.

In this setting, the Communist Party and the Soviet government are working unceasingly to strengthen the defensive might of the Land of the Soviets and to increase the combat readiness of our Armed Forces. The dangerous schemes of the imperialists of the USA and other states of the aggressive NATO bloc and their supporters, the Chinese hegemonists, require constant vigilance from our military aviators and a masterful knowledge of the complex technology that is in the inventory of the units and subunits of the VVS.

In the 1970's, flying platforms having different modifications and designations were built in our country. These are called third and fourth generation aircraft. Their quantitative indicators are: speed, from Mach 2 to 2.5; altitude, from tens of meters to several tens of kilometers; and improved aerodynamic characteristics that allow a landing run to be decreased substantially because of great maneuvering capabilities.

But the matter is not only and not so much one of quantitative indicators. The uniqueness of the present stage of the revolution in military affairs lies in the fact that the emphasis in the development of armament systems is concentrated on improving their qualitative aspects. In addition, the emergence of nuclear weapons has brought forth the problem of developing carriers that would be capable of delivering warheads at great distances, at high speed and would be able to successfully overcome enemy PVO [air defenses]. Together with increasing the power of both nuclear and conventional warheads, there was a struggle to increase the speed, range and load-carrying capacity of carriers. Military aviation became supersonic and missile-carrying. Further development of flying platforms went along the path of increasing the effectiveness of their utilization and improving their methods of control. This task involves a broad range of issues. Aircraft and helicopters must be maximally adapted to operations under various climatic and geographic conditions, short runways and unpaved airfields. This is achieved by using special aerodynamic forms, variable geometry wings, increased mechanization, controllable engine nozzles, etc.

Modern combat requires a pilot to approach the area of the target and destroy it or drop paratroops on a given area under the most complex conditions. To do this, the aircraft or helicopter has to be equipped with perfected, automatic navigational and sight apparatuses, using radio-technological, inertial, radar, infrared and other devices. All this apparatus is integrated into onboard pilot and navigational systems, the basis of which is an airborne digital computer. It processes signals emanating from different sensors and, in accordance with a flight program input in advance, it develops the commands necessary for the autopilot and other apparatus.

Finally, the special nature of a flight with great supersonic speed presupposes a high degree of automation in controlling the aircraft at every stage. Nowadays, ASU [automated control systems] permit the pilot to guide the

aircraft along a given route, accomplish necessary vertical and horizontal maneuvers, approach the target, lay his bombs and return to his own or to an auxiliary airfield.

The saturation of an aircraft with various apparatus and devices has led to a development of airborne automated systems of supplying electricity, the power of which at times exceeds one-half million watts. It is not difficult to reach a conclusion from this: The flying platform of our days constitutes highly mechanized, automated, electrified and well-armed machine that is the focus of the latest achievements of science and technology and which is capable of carrying out a broad spectrum of varied missions.

The formation of the Air Fleet of the Land of the Soviets is the result of constant care to improve the Air Forces by the Communist Party, the Central Committee, the CC Politburo, and the CC CPSU General Secretary, Chairman of the USSR Supreme Soviet Presidium, Chairman of the Defense Council, Marshal of the Soviet Union, Comrade L.I. Brezhnev. This is a result of the tremendous successes of the socialist economy in a developed socialism. This is the achievement of our country in the fields of science and technology, and the selfless labor of workers, technicians, engineers, designers and scientists.

A great contribution in perfecting aviation technology is made by the design collectives headed by R. Belyakov, G. Novozhilov, A. Tupolev, A. Yakovlev, O. Antonov, S. Mikheyev and M. Tishchenko. A further improvement in flight and tactical data of our aircraft supported the successful development of our engine design. Modern supersonic aircraft are equipped with powerful, light and economic power plants designed in collectives headed by A. Lyul'ka, N. Kuznetsov, P. Solov'yev, S. Izotov and V. Lotarev.

The fact that the USSR today posseses a powerful Air Fleet is due to the important roles played by scientific research institutions, wonderful scientists like G. Svishchev, S. Shlyakhtenko, Ye. Fedosov, P. Belyanin, V. Utkin and others, and a large contingent of courageous test pilots who displayed great composure and mastery in assimilating new aviation technology.

In the six decades that have passed since the USSR was founded, we have well-qualified cadres ready: Pilots, engineers and technicians. Representatives of nearly all union and autonomous republics serve in the VVS. Aviation industry has been established in different areas of our great Motherland. The Air Fleet of the USSR is equipped with such passenger airliners as the Il-62, Il-76 T, Il-86, Tu-134, Tu-154, An-22, An-24, An-72, Yak-40, Yak-42 and others.

Soviet designers also achieved great success in the area of helicopter design. During this period they built the Mi-1, Mi-2, Mi-4, Mi-6, Mi-8, Mi-10, Mi-12, Yak-24, Yak-100, Ka-15 M, Ka-26 and Ka-18. Many Soviet rotor-driven aircraft were awarded gold medals at international aviation fairs and received worldwide recognition. Soviet pilots set a number of records with them. At every basic stage of worldwide technical development our helicopter design was in the front ranks or had the leading position. It progressed in its own original way. In this, B. Yu'yev, I. Bratukhin, M. Mil', N. Kamov, A. Yakovlev and others deserve merit.

During the postwar period I was able to go to the Le Bourget Airshow more than once. And the Soviet pavillion was always overfilled with spectators. Visitors familiarized themselves with achievements of Soviet aviation and cosmonautics with great attention.

The successes of our Air Fleet, excellent aviation technology, the existence of qualified scientific and technical cadres and the high level of Soviet science permit one to draw the following conclusion: In the 1980's and subsequent years, progress in aviation will be marked by regular achievements in designing new models of airborne platforms which will raise even higher the prestige of our country that is marching in the vanguard of scientific-technical progress.

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SUPPORT SERVICES: TRAINING IN A MAINTENANCE UNIT DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 36-37

[Article by Captain Yu. Pogrebnyak, deputy chief for political affairs, Technical Maintenance Unit: "An Aircraft Entered the TECh (Technical Maintenance Unit)"]

[Text] As the significant date, the 60th anniversary of the founding of the USSR approaches, the flame of socialist competition becomes more alive. One of the points in the collective responsibilities for aviators states that "the quality of preventive measures in aviation technology should be raised in every way." Every specialist in the technical maintenance unit is working according to his conscience and guarantees the outstanding quality of periodic maintenance. Thanks to extremely keen competition, the time an aircraft spends in the TECh has been decreased to a minimum.

We have a special requirement, because the regiment initiated the competition among the VVS [Air Forces] aviation collectives of the okrug. And it should be said that the servicemen of the TECh did a great deal in their first period of training in order to support the high rate of combat readiness of the aircraft service facility.

The TECh has built a solid foundation for systematically raising the labor productivity of specialists; there is an effective use of control and measurement devices and instruments; and there is a constant effort to save electric energy, materiel and other resources. Also, a certain amount of experience has been gained for further improving the training and material base, the training methods and the education of specialists.

Military personnel of many nationalities serve in the subunit. Among them are Russians, Ukrainians, Armenians, Georgians, Tatars and Lezgins. They are united by love for their socialist Motherland, an indestructable fraternal friendship, and loyalty to their oath and the regimental Combat Banner.

A little over a year has passed since Komsomol member, Engineer-Lieutenant Marat Akhmedov arrived in our collective for service. Energetic and full of initiative, the officer immediately drew attention to himself from his colleagues because of his good-natured attitude toward work. Taking over ad-

vanced methods of servicing aircraft systems from experienced colleagues, today he has the knowledge to accomplish any kind of work on the aircraft or engine, and competently controls the activities of his subordinates.

The length of service in the TECh is not great for Komsomol member, Senior Lieutenant of the Technical Service Oleg Dement'yev either, but the officer has already won prestige among the personnel. Now he is a specialist first class and one of the best group directors for political studies.

A healthy moral atmosphere in the collective and a high moral-political enthusiasm which has enveloped the personnel also have a beneficial effect on the quality of periodic maintenantce work and on the state of military discipline. An example to coworkers is given by the right-flank socialist competition. Among them is a unit veteran, Warrant Officer Yuriy Morozov. He has been serving in the army over 25 years. He has been working good-naturedly in the TECh for many years, carrying out the duties of senior aviation mechanic. When communist Morozov works on an aircraft, it is a pleasure to look at him. Everything he needs is at hand and instruments are laid out neatly. The warrant officer will not step out onto the surface of the winged machine without laying a small rug down first. The quality of work done by him is only the best. This military leader has been awarded the highest qualification level of "master," and his military duties have been recognized by the medal, "For Military Valor, 2nd Class."

In the competition for a worthy celebration of the 60th anniversary of the founding of the USSR, a first class specialist, Warrant Officer D. Dzhamalov is also marching among the right-flank men. He has an excellent knowledge of the complex systems of the modern fighter aircraft, which has incorporated the achievements of Soviet science and technology. Dzhamalov can successfully perform preventive maintenance on any system and any component of the aircraft. His talent has been revealed more than once in performing periodic maintenance on aviation equipment. What makes Dzhabaldin Dzhamalov carry out his duties irreproachably are a faultless industriousness, initiative and an exact adherence to all document requirements that specify the rules for servicing modern aviation systems. He has a solid reputation as one of the best TECh specialists.

The fact that the group for periodic maintenance on aircraft and engines has been outstanding for nearly three years now is, without question, a great credit to the first class specialists. By their expertise, selflessness and strict observance of the requirements of the military oath and regulations, they attract young people to do good work and through their personal example show how the Fatherland should be served.

Senior Lieutenant of the Technical Service S. Stepanov has been heading an outstanding collective for several years. He is endowed with fastidiousness and the ability to motivate people to achieve positive results in difficult work. Communist Stepanov knows well the capabilities of each subordinate and because he does, he is able to distribute tasks most logically when it comes to doing complex technical operations. He plans the specialists' work in detail and gives them all the necessary support. He has set up an absolute control.

Still fresh in Stepanov's mind is the final test he had after the first period of training. The servicemen of the group were required to change an aircraft engine in a compressed period of time. They had to work in an uninterrupted cycle. They all understood that they had to accomplish a large number of operations as quickly as possible and with the best quality of work. The chief, and the party and Komsomol organization of the TECh whipped up the personnel into a good combat mode. Thanks to a strict organization and high technological discipline, the servicemen changed the power system in the allotted time and received an outstanding rating.

In addition to experienced technicians and mechanics we have many young people. Lieutenant of Technical Service Vasiliy Kashkov arrived in the unit only two years ago. At first he was allowed to service aircraft. But soon, people began talking about the young officer as a future specialist. Some time later, communist Kashkov did in fact become one of the best. The command officials transferred him to the TECh as a technician in a group doing periodic maintenance on aircraft and engines. The young officer is working hard with great enthusiasm and diligence. No matter what job he has to do, he does it conscientiously. Komsomol members unanimously elected him secretary of the subunit VLKSM [Komsomol] committee. Vasiliy takes this responsible job seriously. Under his direction the VLKSM committee is now conducting a large project on studying the materials of the 19th Komsomol Congress.

Now, during the period of intensive summer training, the workload for TECh personnel has increased. But the collective can handle difficulties. First of all, we have begun to make better use of productive capabilities and various technological devices. Having a full range of equipment is one of the important conditions for increasing the effectiveness of periodic maintenance. This is achieved, above all, by detailed planning of work on aviation equipment, by the performance of servicemen, by the timely acceptance of aircraft and by an exact determination of the technical condition of its systems, assembly units and mechanisms. The basis for future success is already laid out at this stage.

The collective conducts a constant search for unused reserves, and there is a persistent struggle for high quality work. Thus, at one time we thought a great deal about how to decrease the amount of labor and to increase productivity. There were substantive discussions at party meetings and official conferences on the effectiveness potential of the TECh, and how it could be increased. As a result of a large organizational project in the subunit, machines, equipment, apparatuses and devices began to be used more efficiently. Now we have a rule: Prior to beginning periodic maintenance, the TECh chief and the group chiefs determine who will receive what equipment and how it will be most effectively used.

In this regard, the group for radar equipment, headed by officer V. Guz', deserves attention. Instruments and other control and testing apparatus is maintained here in mint condition and is used only by assignment. They are distributed in such a way that there will not be any idle time, especially through the fault of group specialists.

The TECh has eliminated cases of holding up aircraft on periodic maintenance; the replacement rate has increased, and personnel have begun to value their time more and to observe the daily schedule. And this has been achieved not only because control has been strengthened, but also thanks to detailed organizational-technical measures. Thus, in the radio and radar equipment group, work places and technological service cards have been improved, and manpower and equipment is distributed better. This has significantly increased the quality of periodic maintenance and labor productivity in the process of servicing aircraft radar equipment.

We devote a great deal of attention to economizing and savings, and to efficient use of materials, electric power and other resources. Personnel participate most actively in this movement. A lathe, apparatus or workbench plugged out in time is also a contribution to the economy. The TECh chief and the party and Komsomol organizations of the subunit constantly remind servicemen of this.

Socialist competition also plays a large role. It is directed at further improving the educational and production process and the quality of periodic maintenance, as well as supporting a healthy moral atmosphere in the collective. In conducting competition, Lenin's principles for organizing it are followed: comparison of results, publicity and the opportunity to repeat the advanced experience. And in the TECh, advanced experience is valued.

Specialists picked up much valuable information at the republic fair on the achievements of the national economy, as well as at the VDNKh [Exhibition of National Economic Achievements] of the USSR. And here, our innovators should be mentioned. Senior Lieutenant of the Technical Service V. Grechuk and Warrant Officer Yu. Morozov made an apparatus for testing the pressurization of an aircraft fuel system. These handymen built a device for charging dampers and an apparatus for dismantling the chassis' main wheel bearings. An all-purpose panel for controlling a tape recorder installed on board a fighter aircraft allowed a 50 % decrease in the time it takes to check the apparatus. As a result, group labor productivity increased significantly. In this connection one cannot omit the self-contained compressor unit either, which was built in our TECh. It provides the capability of carrying out riveting, drilling and other aviation technology work under field conditions. Thanks to this innovation, the mobility of the subunit and its combat readiness have increased.

High qualification levels and conscientiously and knowledgeably organized labor permits specialists to successfully solve problems in the intensive period of summer training. The servicemen of the TECh live, in this year of the 60th anniversary of the founding of the USSR, for aiming at greater achievements in supporting aviation technology to be in constant combat readiness and for an exacting assessment of their activities. They are fully resolved to conquer new heights in training, to accomplish socialist responsibilities with honor and to preserve the title of outstanding military collective of the subunit.

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SPACE: GROUND SUPPORT FOR SPACE FLIGHTS DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 40-41

[Article by G. Irinin, candidate of technical sciences, "To See the Invisible"]

[Text] The first attempts to take measurements and control the work of machines from a distance date back to the end of the 19th century. This new trend came to be called telemechanics. And after one half century, the avalanche-like process of perfecting radiolocation and computer technology led to distance control, which allowed a shift for creating radio control systems in various areas of human activity. Now such systems are called telemetric, and they were further developed by astronautics.

Sensors installed on board sputniks [satellites] and missiles, measure and control temperature conditions of the most important modes, pressure, vibration, overloads and many other parameters. They support the control of guidance and automation systems, pneumohydraulic systems, as well as other units and apparatuses. Using these parameter measurements, or, as the specialists say, telemetry, they can evaluate the soundness of onboard apparatus and, if necessary, take measures to transfer it to reserve units. Thus, the use of radio waves for observing the invisible has today turned into the basic form of controlling space technology.

The collection of information from the sputnik, its transmittal to Earth and to the Flight Control Center, and dissemination to specialists for study and analysis comprises the telemetric system. It includes the onboard telemetric apparatus, ground receiving and recording stations, apparatus for processing information and various types of communication channels.

The telemetric system should insure completeness, high quality and operability in presenting information. The first requirement is to have enough telemetry sensors. Thus on the "Molniya" type sputniks, the number of controlled parameters is around 500, and on the manned "Soyuz" vehicle and the "Salyut" station there are 2000-3000 and sometimes more. With regard to information received, the figures are really astronomical. For example, from the orbiting "Salyut-6" and "Soyuz" complex, around 800,000 units of information were received and processed every second, which in volume is equivalent

to the text of an entire issue of the "Aviatsiya i kosmonavtika" journal. This flow, if measures are not taken to direct it to a regulated channel, could literally choke off all communication channels. After all, the capacity of each channel is limited. How then do they combine completeness, operability and quality of information received?

First of all, by condensing the channels. There are two such known methods -- frequency and time. The first method is based on spacing signal frequencies from different sensors, which significantly increases the production of one channel. On Earth, using a frequency filter, the signals are restored. In time condensing, a system of onboard switching is introduced, with the aid of which requested information can be provided by sensors in a given sequence. In so doing, only data of that particular moment are fixed [i.e. recorded], after which the next sensor is queried. In this way, telemetry data, transmitted through a radio channel, comprise a chain of encyphered signals having a specific sequence of queries.

The telemetry system is also being developed in conjunction with these condensing methods.. The frequency method operates within analog systems where signals preserve their form, and the time system operates in number systems which separate them into quanta of time and amplitude (Fig. 1). Naturally, each of these systems has its advantages and shortcomings; therefore, their application is determined primarily by the quality of the information received. Thus, for recording quickly occurring processes, such as vibration in certain constructed parts, analog systems are preferable, because they provide a more complete picture for analysis and conclusions on how apparatuses, components and constructed parts are working. However, the volume of information they transmit is limited. Due to interference arising as a result of the superposition of spectra in different channels, no more than 30-50 sensors can be serviced. Digital telemetry systems are free of this deficiency and serve for transmitting a large volume of information. They have the following operational parameters: Number of channels, 2000-3000; query frequencies, 0.02-100 hertz; information transmission error, up to one percent; total rate of transmission, up to one million binary units per second; probability of error during maximum load, one binary discharge per second.

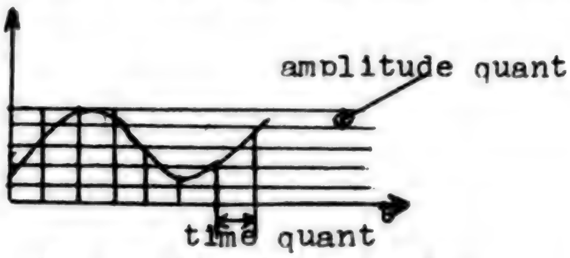
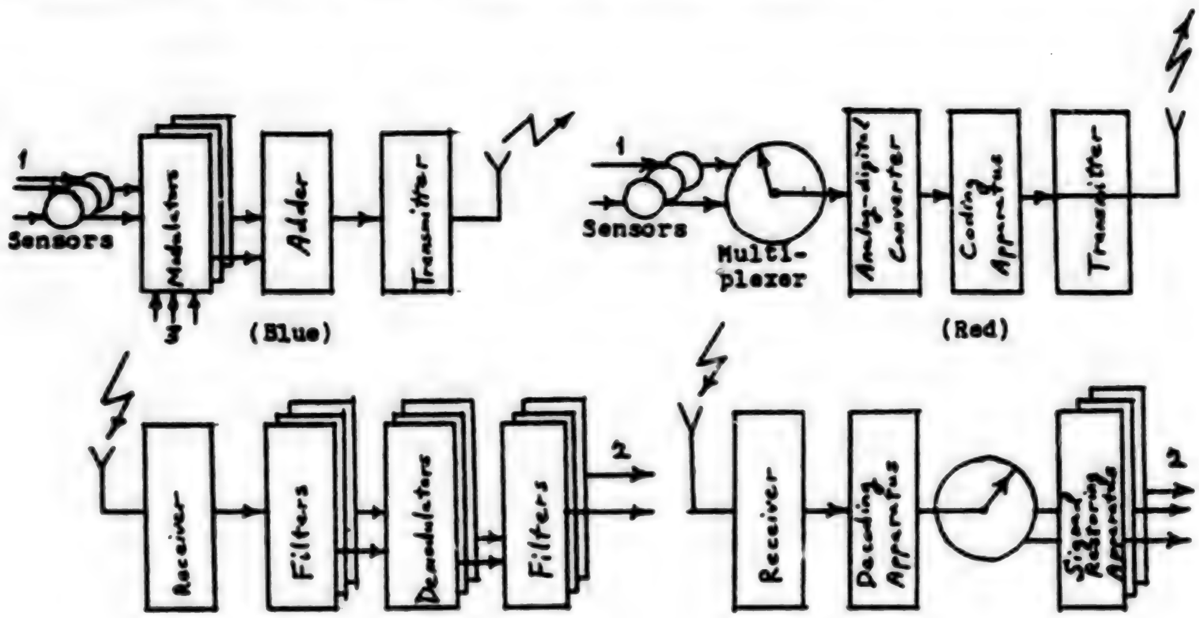


Fig. 1. Telemetric signals.

Let us examine the principles underlying the construction of these systems. Signals from the sensors of an analog telemetry system having channel frequency multiplexing (Fig. 2) are sent to modulators, the alternate inputs of which receive harmonic voltage from subcarrier frequencies. The latter are modulated by the initial information which acts on one of its parameters: amplitude, frequency or phase. Thus the spectrum of the initial signal is

transferred to a part of the spectrum for the group signal that is allocated to it. The subcarrier frequencies are selected in the range of hundreds of hertz, or tens of kilohertz, and the intervals between them depend on the kind of modulation and spectrum of the initial signal.

Fig. 2. Diagram of the analog (with frequency condensed channels) and digital (with time condensed channels) telemetric systems: 1 - Value measured; 2 - Measurement result; 3 - Subcarrier oscillations.



(Blue) (Red)

Upon leaving the sum circuit, the group signal goes to the transmitter, where the carrier frequency of the radio line is modulated, and from there it goes into the air. The receiver of the ground telemetry station, tuned to the given value of the carrier frequency, catches this high frequency signal with the aid of an antenna. Then the frequency filters of the subcarrier frequencies select frequency bands occupied by different channels, while the demodulators and subsequent filters change back the signals into the form they had when they were input into the onboard modulators. The measurement results received are recorded and analyzed.

The digital telemetry system with time channel multiplexing (Fig. 2), allows greater accuracy to be achieved, because distortion of binary signals is comparatively easily eliminated by the regeneration of impulses. A control box collects information from the sensors. It also activates amplitude-impulse voltage modulation, that is time quant. The principle for this is, as follows: The scale of possible values for the voltage of a signal is broken down into a certain number of quant levels of amplitude, and its true size is rounded off to the nearest permissible level. As a result, during the output, there is a number of impulses that are spaced in time, the amplitudes of which are equal to the momentary values of the signal voltage. Here, also, the amplitude values of these impulses are translated into the

binary calculating system. Then the digital signal is encoded and sent to the transmitter which modulates the carrier frequency. On the receiving side, all operations are repeated, with the difference being that they go in reverse order.

The information in these systems is transmitted to frames consisting of service and information units. The former includes synchronized sending, which helps support synchronous work of onboard and ground apparatuses, as well as service information, such as sputnik number, telemeasurement programs and other. The second part of the frame contains words, each of which carries direct information from a specified and predesignated channel. Finally, the measurements are sent either to a computer for processing or are displayed on operators' screens and digital printing apparatuses.

The operational schedule for onboard telemetry systems depends essentially on the duration of communication with Earth. As a rule, communication is limited, inasmuch as sputniks are in radio contact zones of ground measuring stations for a relatively short time. Telemetric control, however, should be conducted throughout the entire flight. A compromise solution has been found: Continuous recording of information being measured onto onboard tape recorders and a subsequent transmittal to the measurement point during communication with Earth.

With all the advantages of digital telemetry systems, they also have a deficiency: Low informational flexibility, which is an absolute necessity for manned spacecraft. For example, data connected with cosmonauts' vital activities must be entered on the onboard diagnostic apparatus. This was the reason for working out telemetry systems of a new type: Adaptive- address systems. Their principal difference lies in the method of collecting information. Instead of a cyclical multiplexer, an address multiplexer is used here: The prominent signal of that sensor whose address went into the input of the multiplexer. The control unit directs its operations. This type of system can simultaneously service not only the radio line, but also the cosmonauts, upon their request.

We already spoke about the difficulties in connection with transmitting a large flow of measurements. In telemetry systems, together with channel multiplexing, there is also onboard processing of information, usually with the goal of extracting overflow data. The problem is that many parameters change quite rarely and, therefore, transmit only partial data, eliminating the rest. Also used is interpretation processing, when the data dump takes place only in the event of an abnormal behavior of controlled parameters. This is one way of easing the load on the radio line and the ground information processing system and increase the autonomic operations of telemetry systems.

Information processing in telemetry systems is mostly automated. It is implemented through all-purpose and special computers. There are two possible variants in using apparatus for automatic information processing. In the first, the so-called express mode, the processing program is input into the apparatus of the measurement point from the Flight Control Center prior

to the communication session. Information, at the same speed at which it is received, goes to the information-computer complex of the Center, and processing results are transmitted to display monitors. Specialists get an idea of how systems for which they are responsible are working, and they receive this information in an operational and visual form, which can easily be absorbed. The data received is documented right on the spot. This processing is usually applicable for those parameters that, when they deviate from the norm, can be given control commands. Here, too, data on the condition of the cosmonauts is also processed. In the second mode, the telemetry information, prior to sending it to the Flight Control Center, is processed by the computer center of the measurement point. Data that are questionable or clearly deviating from the norm are discarded, figuratively speaking, and the information is refined and condensed. Its final processing takes place in a subsequent period. This information allows assessment of both the operations of separate systems, as well as the spacecraft as a whole. The results allow decisions to be made on whether to effect further improvements or modifications of onboard systems.

Modern telemetry stations are characterized by their universality. They have a wide range of frequencies, broad scope of informatics, automatic tracking of sputniks by frequency, azimuth and angle elevation, and automated programmed control for inputting the target designation and frequencies for tuning receivers, all of which allow these stations to operate with space apparatus of all types that have to service ground equipment for supporting flights.

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INTERVIEW DISCUSSES TRAINING FOR, USE OF AERIAL SPACE PHOTOGRAPHY

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 82 (signed to press 1 Jun 82) pp 44-45

[Interview with Major General of Aviation A. Filipchenko, twice Hero of the Soviet Union, pilot-cosmonaut of the USSR: "In Class, in the Air and in Orbit"; date, place and occasion not specified]

We are in the building of the school complex at the Center for Cosmonaut Training imeni Yu. A. Gagarin. Escorting us is twice Hero of the Soviet Union, pilot-cosmonaut of the USSR, Major General of Aviation A. Filipchenko. We stop before a door with the sign, "Class for Space Natural History."

[Question] ANATOLIY VASIL'YEVICH, PLEASE TELL US THE PURPOSE OF THIS CLASS.

[Answer] From their orbit, cosmonauts have to know how to "read" an area and quickly get a fix on what they have seen. In order to instill these skills, special studies are conducted. The television screens installed at every working position reproduce an area which appears as it would to astronauts out in space. In order to get a fix on what he has seen, he turns to graphic methods -- notes and sketches. Or, he uses a tape recorder.

Our class is also equipped with apparatus for demonstrating devices and methods for deciphering photographs from space. The multiscreen can simultaneously reproduce six photographs of the same area, taken by the MKF-6M camera in different ranges of the spectrum, and these images can then be laid over each other. If desired, they may be made different colors with filters. Then, for example, from the photograph one can determine winter field crops, where the new shoots are good and strong, and where there is something wrong. Different shades of color can show this. You can also distinguish coniferous trees in a mixed forest ...

In addition to the multi-zone MKF-6M camera, which is now being installed on Soviet "Salyut" orbital stations, the GDR [German Democratic Republic] people's institution of "Karl Zeiss Jena" has made a special project instrument for processing space photographs. It allows images of individual photo frames to be combined -- with great exactness -- into one, and with the aid of different changeable light filters, it can isolate necessary elements and details. It turned out that this work is delicate and time-consuming.

In order to accelerate the process, a computer is used, which calculates by spectral characteristics of objects, the best combinations of frames and light filters.

[Question] WHEN ONE LOOKS AT PHOTOGRAPHS, MAPS AND PLANS PRESENTED IN THIS CLASS AND HEARS ABOUT THE EFFECTIVENESS OF SPACE NATURAL HISTORY, IT IS DIFFICULT TO BELIEVE THAT EVERYTHING BEGAN WITH A FEW FRAMES TAKEN BY GERMAN STEPANOVICH TITOV DURING HIS "VOSTOK-2" FLIGHT AND WITH THE FIRST "PORTRAIT" OF EARTH IN ITS "FULL MAGNITUDE," RECEIVED BY ONE OF OUR "ZONDS" THAT CIRCUMNAVIGATED THE MOON. DON'T YOU HAVE THIS FEELING?

[Answer It is true. The effectiveness of studying nature and natural resources of the Earth from outer space was a pleasant surprise for everyone, especially scientists. Academician Sidorenko tells how, when the first spaceships went out on their flights, many thought that space flights would not have a substantive influence on natural sciences. But, only a short time passed, and scientists saw what a tremendous effect space research has for geography, geodesy and cartography, geology, meteorology, oceanology, agronomy, ecology, the study of water resources, research on vegetation and many other scientific and economic activities of man. Furthermore, space research sometimes leads to changes in natural sciences. And since they all have to do with the practice and everyday needs of people, these changes have a positive influence on resolving problems of the national econemy.

[Question] HOW DO FUTURE COSMONAUTS FAMILIARIZE THEMSELVES WITH THE BASICS OF THIS TREND IN SPACE RESEARCH?

[Answer] Training in outer space natural history encompasses several stages. At first here, in the Center, future cosmonauts take a general theory course; they attend lectures on the basics of outer space natural history and learn about its problems, and methods and means of exploring Earth from outer space. Lectures are given by our specialists and by collaborators of the "Priroda" State Center. Then specialists of main and leading branch institutes of ministries and departments familiarize the cosmonauts with the basic directions of research: geology, oceanology, agriculture and forestry, soil science, hydrology, glaciology and protection of the environment.

After this, the cosmonauts begin their aero-visual training. Here, theory is reinforced by practice. Laboratory aircraft fly over several land and sea test areas along designated routes. These land and sea surface areas are selected in characteristic physical and geographical zones of our country. There are several such expeditions each year. Cosmonauts are accompanied by specialists of whichever branch of research is to be emphasized during that particular mission. For example, geologists participated in the last expedition. The route passed over the Caspian and Central Asia. The laboratory aircraft are equipped with quartz observation portholes, just as on an orbiting station, and with illuminators and blisters. The cosmonauts take maps, aids, photo equipment and binoculars with them.

During this training they are taught to detect necessary objects from the air; they are shown their vertical and oblique characteristics; and they

are familiarized with conditions for photography and observation, close to real conditions. And although the orbit altitude of the station is several tens more than the altitude of the laboratory aircraft, the cosmonauts are unanimous in their opinion that this training provides an opportunity to be well-prepared for work in space.

When the crew has been formed, it begins training in accordance with the flight program. During this time, the cosmonauts maintain close ties with scientists and specialists of those scientific disciplines in the interest of which work will be conducted in space.

[Question] WHY IS IT NECESSARY TO EXPLORE EARTH FROM ABOARD AN ORBITING STATION, USING PEOPLE?

[Answer] It is more expedient to test photographic equipment and to develop means for using it with a manned spacecraft. The cosmonaut collects and checks the equipment, works to adjust and regulate it, and selects the necessary work modes and objects for research. He applies the research methods that respond best to the flight conditions and to the assigned mission. This cannot be done by automatic means alone.

Man is capable of quickly adapting to changing conditions; he can work simultaneously on several programs; he can select his method of work and correct his own errors. He can creatively resolve problems that arise, on the basis of logical analysis and experience acquired during training and preparation for the flight. And our cosmonauts have demonstrated this more than once.

[Question] HOW EFFECTIVE HAS BEEN THE PARTICIPATION OF INTERNATIONAL CREWS IN NATURAL HISTORY RESEARCH?

[Answer] Cosmonauts of socialist countries were the first to participate in this kind of research. They went through outer space natural history training in Zvyozdnyy, learned the methodology for visual observation, as well as the workings of mobile apparatus and the stationary MKF-6M and KATE-140 cameras, and the "Spectr - 15" spectrometer.

The cosmonauts improved modes and methods of photography, checked the correctness of the photo transmissions as to the color of the Earth's ground covering, developed methods of visually recognizing objects and their condition, researched the water areas of seas and oceans and studied large and well-hidden geological formations -- ringed, dome-shaped and crater-shaped structures. They discovered and described polluted areas, land and ocean surfaces, and elemental phenomena -- fires, floods and hurricane. They conducted scheduled cartographing of forests and agricultural arable land, in an attempt to make prognoses of their productivity in their territories of member countries of the "Intercosmos" program and they determined the characteristics of the hydrographic network.

As a result of work accomplished on "Salyut-6," specialists of socialist countries received several thousand photographs from outer space, notes in

logbooks, sketches, cassettes with spectrograms and operational information from the spaceship via radio channels.

Our friends acquired good practice and work experience in the area of outer space natural history. This will help them in further researching nature and the natural resources of their countries.

[Question] IT IS KNOWN THAT PROCESSING PHOTOGRAPHS FROM OUTER SPACE IS LABOR INTENSIVE WITHOUT AUTOMATION. WHAT IS BEING DONE TO AUTOMATE THIS PROCESS?

[Answer] In accordance with an initiative of the USSR State Committee on Science and Technology, several coordinated programs have been developed to deal with this problem. One of them provides for the establishment of interdepartmental centers for processing information from outer space. Experimental operations have already began in one of these centers and the first results are in.

A modular, program-directed KAMAK system has been designed for imagery processing. Corresponding Member of the USSR Academy of Sciences Nesterikhin was saying that using this system as a base, they were able to unite functional subsystems into a single complex, which included several different kinds of computers and "technological" equipment, i.e., input and output systems, storage and display of optical information. A precision "Zenit" system is used to input photographic images into the computer. This system combines a high rate of speed in "reading" the images (up to 100,000 photo elements per second) with micron photo resolution. During the process of being read, the image, as it were, is broken up into very small elements or cells. The integrity of their brightness is expressed by numerals which, together with coordinates of specific image elements, are recorded in the computer memory. Programmed direction provides the capability of "calling out" several photographs simultaneously from the computer memory.

The experimental center for information processing is equipped with a graph plotter-coder, electronic photoplatter, and a laser apparatus for bringing out half-tone photo images. Also developed is a holographic memory apparatus that allows the storage of a large volume of information for an unlimited time.

The Institute for Automation and Electrometrics of the Siberian Section of the USSR Academy of Sciences has provided mathematical support for simultaneous analysis of six photographs received by the MKF-6M camera in different spectral intervals. An apparatus complex has been developed for imagery analysis, where photographs taken in different spectral zones are combined. Then the computer classifies and "identifies" the subjects of the photography. This is how the condition of agricultural arable lands and the degree of water reservoir pollution are determined; and a correlation is shown between the images received from outer space and the results of ground measurements.

We can visualize what will take place tomorrow in outer space natural history. It includes systematic and complex research on natural processes and

phenomena, as well as mathematical methods and automation in processing information from outer space. And in order for this information to be of high quality, effective and complete, a great deal will depend, as in the past, upon cosmonauts, their knowledge, skills and experience. They require all this here, in the Center for Cosmonaut Training, imeni Yu. A. Gagarin.

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